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TM 9-1785B

WAR DEPARTMENT TECHNICAL MANUAL



Power Train, Suspension, and Equipment
For 18-Ton High Speed Tractor M4

WAR DEPARTMENT

4 APRIL 1944

FOR ORDNANCE PERSONNEL ONLY

WAR DEPARTMENT TECHNICAL MANUAL

TM 9-1785B

ORDNANCE MAINTENANCE

**Power Train, Suspension, and Equipment
For 18-Ton High Speed Tractor M4**



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Washington 25, D. C., 4 April 1944

TM 9-1785B, Ordnance Maintenance: Power Train, Suspension, and Equipment for 18-ton High Speed Tractor M4, is published for the information and guidance of all concerned.

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(For explanation of symbols, see FM 21-6.)

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ORDNANCE MAINTENANCE—POWER TRAIN, SUSPENSION, AND EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4

CHAPTER 1

INTRODUCTION

1. SCOPE.

- a. The instructions contained in this manual are for the information and guidance of personnel charged with the maintenance and repair of the 18-ton High Speed Tractor M4 (fig. 1). These instructions are supplementary to Field and Technical Manuals prepared for the using arms. This manual does not contain information which is intended primarily for the using arms, since such information is available to ordnance maintenance personnel in 100-series Technical Manuals or Field Manuals.
- b. This manual contains a description of, and procedure for, the removal and installation of the cab and seats, power train and components; disassembly, inspection, and repair of the components of the power train, suspensions, winch, power take-off, and pintles. Applicable fits and tolerances for these assemblies and special tools for use in repairing these assemblies are also listed.
- c. TM 9-785 contains operating and lubrication instructions for the vehicle and contains instructions for all maintenance operations allocated to the second echelon.
- d. TM 9-1785A contains instructions for the disassembly, inspection, repair, and assembly of the engine and torque converter used in the tractor.
- e. TM 9-1825A contains instructions for maintenance of the cranking motor, generator, generator regulator, and ignition system.
- f. TM 9-1826C contains instructions for maintenance of the carburetors.
- g. TM 9-1827A contains instructions for maintenance of all components of the air brake system.
- h. TM 9-1828A contains instructions for maintenance of the fuel pump.

2. MWO AND MAJOR UNIT ASSEMBLY REPLACEMENT RECORD.

- a. **Description.** Every vehicle is supplied with a copy of AGO Form No. 478 which provides a means of keeping a record of each MWO completed or major unit assembly replaced. This form include spaces for the vehicle name and U. S. A. Registration Number, instructions for use, and information pertinent to the work accom-

INTRODUCTION

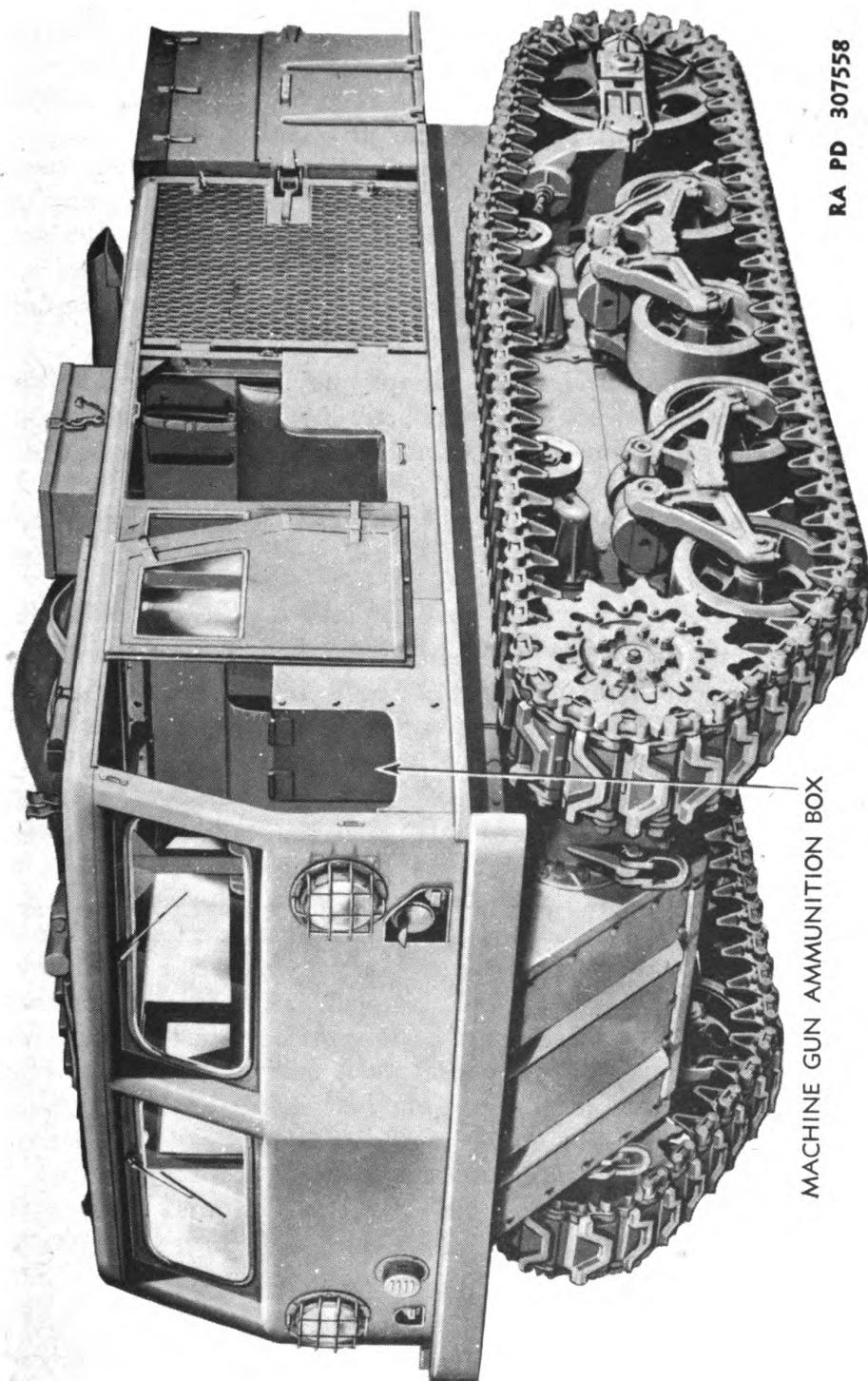


Figure 1 – 18-ton High Speed Tractor M4

ORDNANCE MAINTENANCE - POWER TRAIN, SUSPENSION, AND EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4

plished. It is very important that the form be used as directed and that it remain with the vehicle until the vehicle is removed from service.

b. Instructions for Use. Personnel performing modifications or major unit assembly replacements must record clearly on the form a description of the work completed and must initial the form in the columns provided. When each modification is completed, record the date, hours and mileage, and MWO number. When major unit assemblies, such as engines, transmissions, transfer cases, are replaced, record the date, hours and mileage and nomenclature of the unit assembly. Minor repairs and minor parts and accessory replacements need not be recorded.

c. Early Modifications. Upon receipt by a third or fourth echelon repair facility of a vehicle for modification or repair, maintenance personnel will record the MWO numbers of modifications applied prior to the date of AGO Form No. 478.

CHAPTER 2

CAB AND SEATS

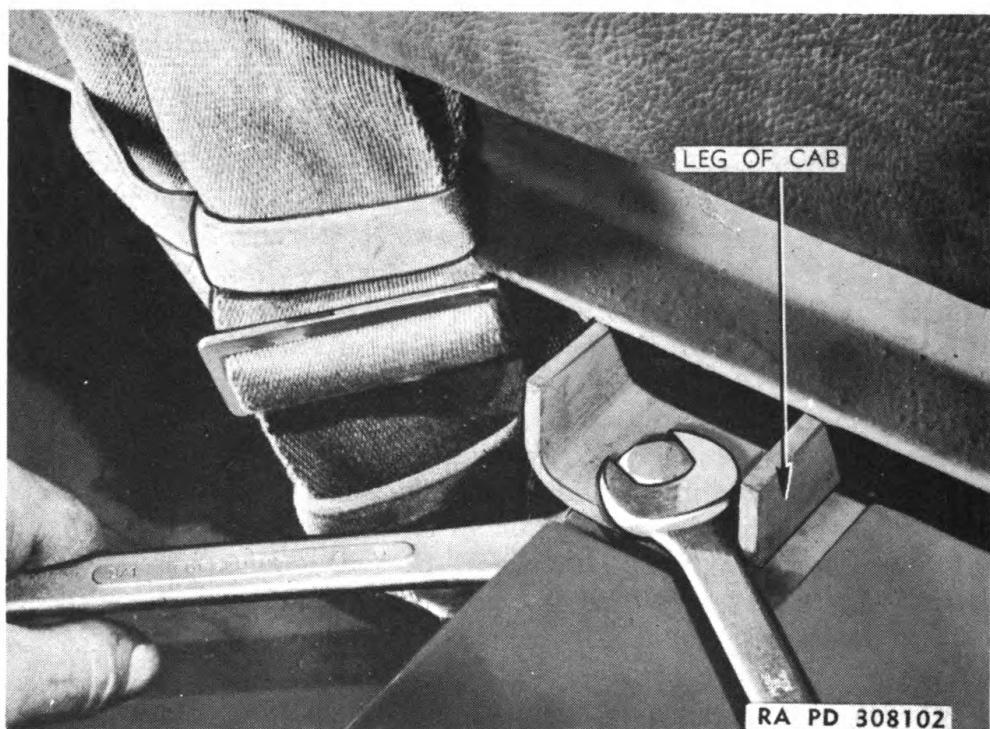
3. DESCRIPTION.

a. The cab covers the front half of the tractor and is divided into two compartments. The single front seat provides seating room for the driver and two men, the two rear seats (which face each other), will seat eight men. Safety belts are provided on seats and all seats are removable. The seat cushions are canvas zipper bags padded with blankets. Pioneer tools, snatch block and chain, spare track blocks, and machine gun tripod are carried on top of cab. A gun ring is provided in top of cab directly over rear seat compartment for mounting and use of a cal. .30 or cal. .50 machine gun. Ammunition for the machine gun is carried in a box at left of driver. Driving controls and instrument panel are mounted inside front panel of cab in easy reach of operator. On later tractors, the cab is equipped with ventilators in front panel and hinged windshields. Hinged storm curtains are provided on sides of cab for use during cold weather operation.

4. REMOVAL.

a. Remove Seats and Disconnect Rear of Cab. Remove all seat cushions and seat plates. Open engine and radiator grilles. Remove the two bolts that attach front angle of left engine hood to rear of cab. Remove eight cap screws from hood and lift off right engine hood. Remove the two bolts that attach radiator expansion tank support bracket to rear of cab. Remove four cap screws and remove right seat back cushion from rear panel of cab. Reach through opening in rear of cab and remove the four bolts in rail of cab supporting water return lines. Raise hinged floor plate and fasten up with snap fastener. Remove six cap screws in rear compartment connecting cab to hull. Loosen clamp bolt and lift inside battery cable from battery post to disconnect battery. Remove four cap screws and one bolt from front floor plate in rear seat compartment and remove plate. Remove bolts and spacers from vent line supporting clips on left floor rail in rear compartment and remove right and left floor rails. Disconnect converter radiator vent line and reserve tank vent line at lower left-rear corner of cab and disconnect radiator vent line from hose at top of radiator supporting frame. Disconnect choke and throttle control brackets from rear of cab.

b. Disconnect Cab From Hull and Disconnect Wires and Controls. Remove 8 bolts that attach rear and center legs of cab to hull (fig. 2). Remove the 22 cap screws from front guard plate below bumper and remove plate. Remove the 3 bolts holding cab

ORDNANCE MAINTENANCE—POWER TRAIN, SUSPENSION, AND EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4**Figure 2 — Disconnecting Cab From Hull**

to right bumper support. Remove wire guard covering wires below instrument panel, then remove the 5 bolts from wire clips (fig. 3). Remove yoke pins to disconnect operating control rods and disconnect rods from air brake application valve lever and electric brake controller lever. Disconnect all wires from brake controller. Disconnect air lines from lower end of tee fitting at bottom of front cab panel, from air line connector below tee fitting, and from both ends of double check valve on floorboard. Remove 6 cap screws attaching bumper to cab. Remove 3 bolts holding right fender to hull in front seat compartment between seat back and bumper. Remove 6 bolts on left side attaching cab to hull. Disconnect both ends of air line leading from brake application valve to tee fitting at center of bumper, remove cap screw from air line clip and remove this air line.

c. Disconnect Instrument Panel and Wires. Remove the four attaching bolts from ends of instrument panel to disconnect panel from dash. Disconnect wire No. 30 from windshield wiper switch, wires Nos. 7, 4, and 3 from terminals of main light switch, No. 5 wire from blackout driving light switch, and No. 60 wire from low air pressure switch. Pull these wires out of clips of instrument panel and lay instrument panel on differential so instruments will not be damaged.

CAB AND SEATS

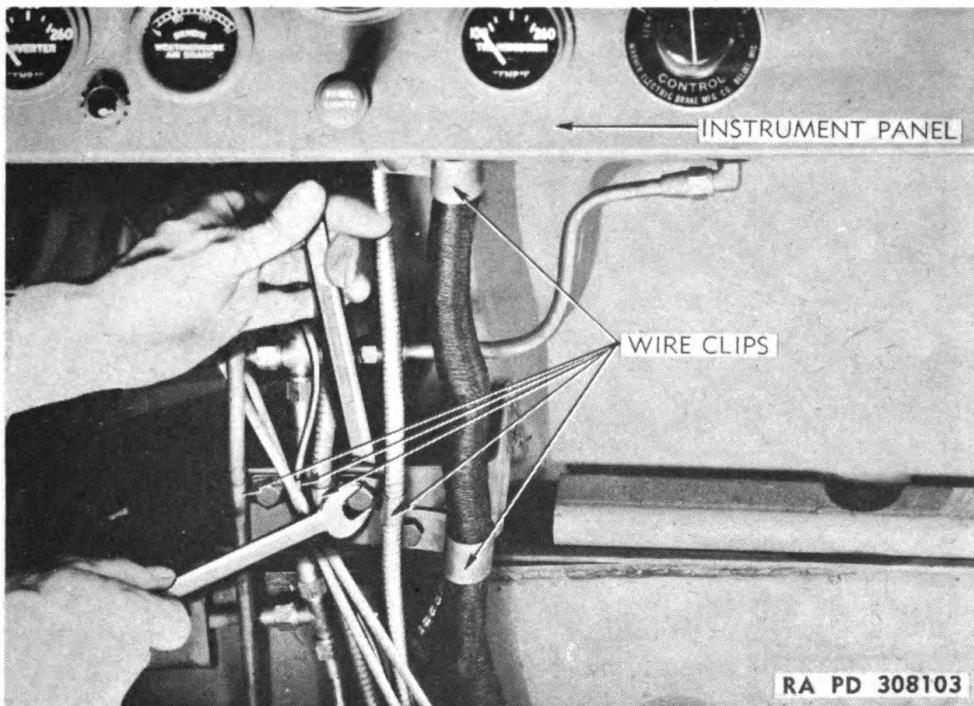
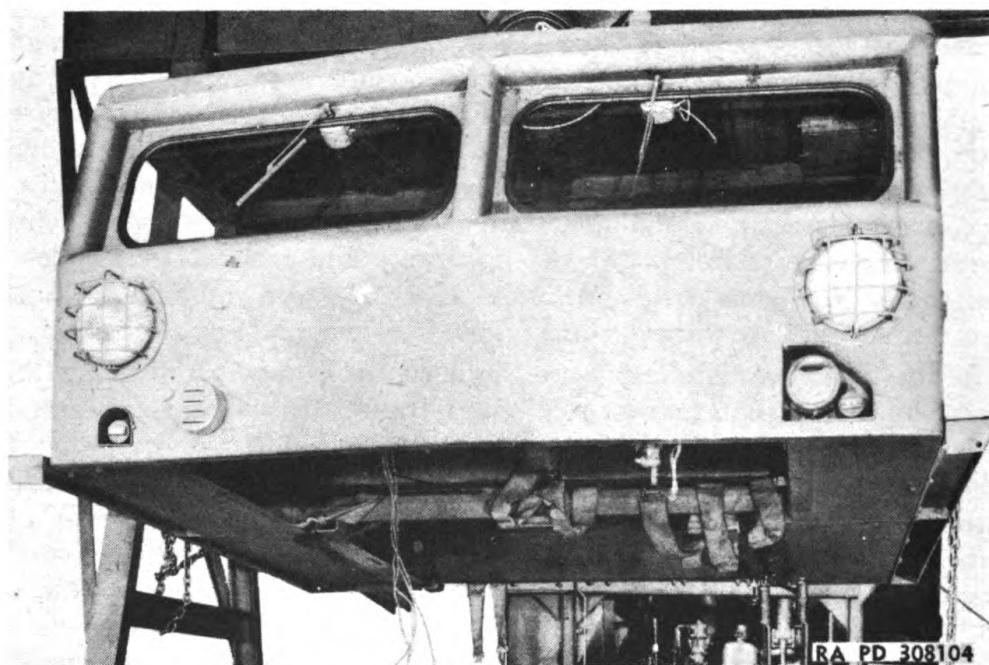


Figure 3 – Removing Bolts From Clips on Cab Bracket

d. Remove Cab Assembly. Remove six bolts attaching cab to rear fenders, then lower chain of hoist through turret and attach it to center post of cab. Hoist cab high enough to clear steering levers and remove cab from tractor (fig. 4).

5. INSTALLATION.

a. Install Cab on Tractor. Lower cab into position on tractor with chain hoist. Use care while lowering assembly into place so that projecting tubes or lines will not be damaged. When assembly is in place, line up holes in hull and cab for attaching bolts with large punch. Install six bolts to attach cab to rear fenders. Install six cap screws inside cab to attach cab to bumper (three of these cap screws also hold wire guards and line clips). Attach rear and center legs of cab to hull with eight bolts. Attach cab to right bumper support with three bolts. Install two cap screws connecting fenders to front bumper. Position right and left floor rails under edge of hull in rear compartment. Attach rails to hull and cab with six cap screws. Install three bolts connecting right fender to hull in front seat compartment between seat back cushion and bumper. Install six bolts in front seat compartment connecting cab to left side of hull (four of these bolts go through bottom of machine gun ammunition box). Use lock washers with all the above bolts and cap screws.

ORDNANCE MAINTENANCE – POWER TRAIN, SUSPENSION, AND EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4**Figure 4 – Lifting Cab From Tractor**

b. Connect Lines, Wires, and Controls. Install four bolts through clips and cab to attach large water return line to lower rear angle of cab (bolt nearest radiator also holds intermediate throttle cross shaft return-spring bracket). Install two bolts in radiator expansion tank support bracket and rear of cab. Connect front angle of left engine hood to rear of cab with two bolts. Install two bolts with spacers in clips supporting torque converter radiator and reserve tank vent lines from left floor rail in rear seat compartment (spacers go between the two clips so that outer clip will clear pipe). Use lock washers on all bolts. Connect converter radiator vent line to hose above radiator supporting frame. Connect the vent pipes to fittings below lower left rear corner of cab. Connect operating control rods with yoke pins and cotter pins and connect air brake application valve and electric brake controller control rods to valve and controller levers. Connect air lines to front and rear of double check valve near clutch pedal, and connect air line to lower ends of tee fitting at bottom of front panel of cab. Raise instrument panel and insert wires Nos. 30, 7, 4, 5, and 3 under clips at back of panel. Refer to wiring diagram in TM 9-785 if necessary, and connect these wires as follows: Connect No. 30 to windshield wiper switch, No. 7 to upper post of main light switch, No. 4 to terminal on main light switch, No. 5 to blackout driving light, No. 3 to terminal of main light switch, and No. 60 to low air pressure switch on dash. Raise instrument panel

CAB AND SEATS

into position and secure with four bolts and lock washers. Connect air lines to tee fitting on dash and application valve. Install cap screw with lock washers to secure line clip to rear of bumper. Connect engine primer line to fittings below floorboard and at rear of pump in instrument panel. Install five bolts with lock washers to secure wire clips to dash bracket (fig. 3). Connect remaining air line above floorboard near bumper. Connect speedometer and tachometer flexible drive shafts to instruments in instrument panel. Install wire guard on dash bracket with four cap screws and lock washers. Connect wires Nos. 8 and 9 to top post of electric brake controller. Connect remaining two wires in loom to lower terminals of controller.

c. Install Floor Plates, Seats, and Front Guard Plate. Install front floorboard plate in rear seat compartment with 4 cap screws and 1 bolt, and lock washers (the bolt goes in upright angle at right of converter). Connect battery cable to battery, then lower hinged floor plate. Install choke and throttle control bracket on rear of cab, then install seat back cushion, covering opening in rear panel of cab. Secure cushion with 4 cap screws and lock washers. Check and adjust, if necessary, all controls as explained in TM 9-785, then place seat plates and cushions in tractor. Install right engine hood with 8 cap screws and lock washers, and close engine and radiator grilles. Install front guard plate on front of tractor with 22 cap screws and lock washers.

**ORDNANCE MAINTENANCE – POWER TRAIN, SUSPENSION, AND
EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4**

CHAPTER 3

POWER TRAIN (LESS TORQUE CONVERTER)

Section I

DESCRIPTION

6. DESCRIPTION OF POWER TRAIN.

a. General Description. The power train, as considered in this chapter, consists of the transmission, differential, and final drive assemblies. The arrangement is similar in all respects to standard tank transmissions. Power developed by the engine is transferred through a hydraulic torque converter (TM 9-1785A) to the transmission and differential, and through the differential to the final drive gears and drive sprockets. The transmission and final drive assemblies are each contained in separate housings bolted to the differential housing. The power take-off is mounted on the transmission case. The entire assembly is assembled and mounted as one unit on the front end of the main frame of vehicle.

b. Lubrication. Oil carried in the final drive housings provides for the lubrication of the final drive gears and bearings. This oil is distributed by the rotation of the gears during operation. The transmission and differential have a common oil supply carried in the housings. An oil pump, mounted on the power take-off draws the oil from a sump in bottom of differential housing. The oil is circulated through manifolds and pipes to gears and bearings which are not adequately lubricated by the oil distributed by the rotating gears. The pump also circulates the oil through the oil cooling radiator where it is cooled.

Section II

REMOVAL

7. REMOVAL OF DIFFERENTIAL, TRANSMISSION AND FINAL DRIVE ASSEMBLY.

a. Remove Cab Assembly. Follow procedure outlined in paragraph 4 to remove cab from tractor.

b. Remove Front Floor Plate and Throttle Cross Shaft Angle. Remove front seat plate. Remove clamp screw in hull drain valve

POWER TRAIN (LESS TORQUE CONVERTER)

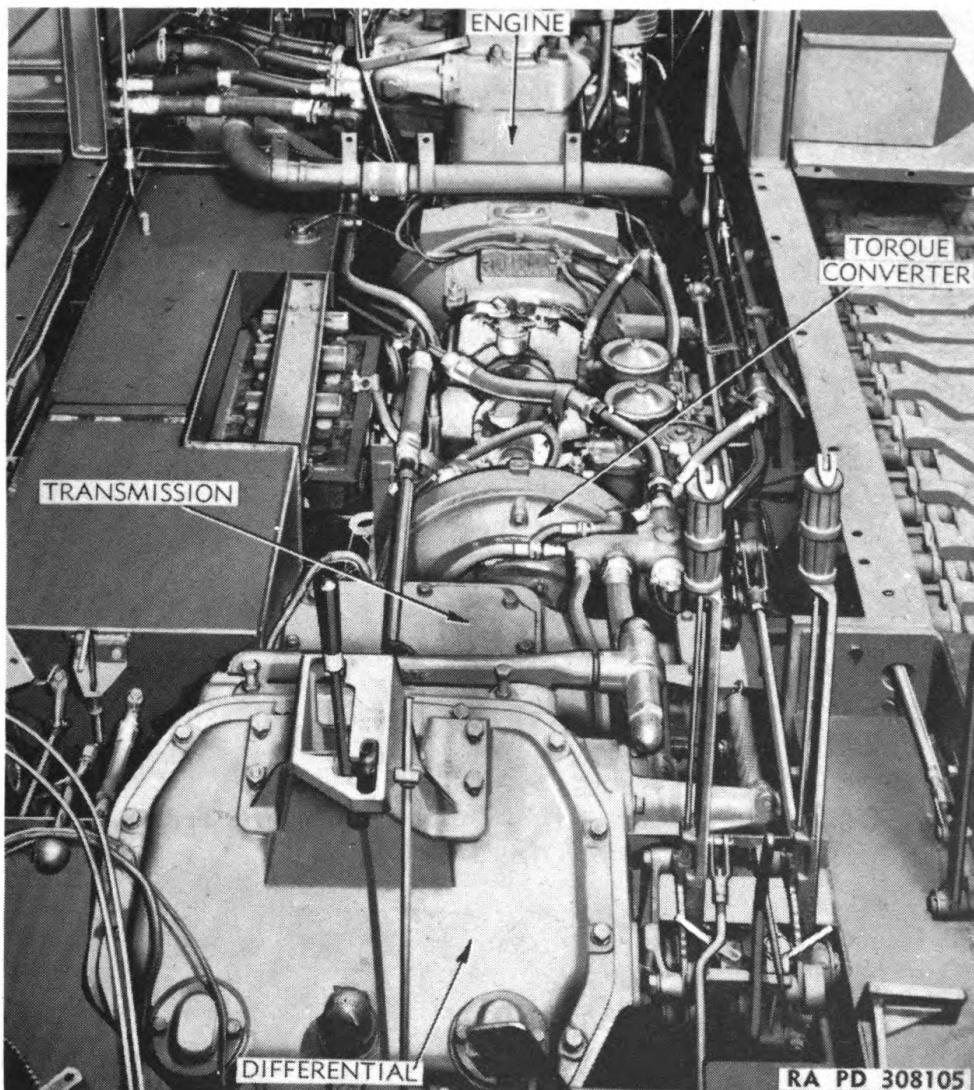


Figure 5 – Tractor With Cab Removed

lever, remove cotter pin and washer from valve crank, and slide upper rod block off crank. Slide crank back to remove lever from crank. Remove cap screw under rear of floor plate that attaches plate to right side of differential case, and the bolt holding right rear side of floor plate to clip on hull. Remove the three cap screws from plate and supporting angle for throttle cross shaft. Remove two cap screws holding floor plate to bumper. Raise hand throttle control rod until lower pin is above floor plate and can be removed. Remove pin from accelerator pedal link, then lift off floor plate. Remove pin from arm and rod at right end of throttle cross shaft. Remove the two cap screws and one bolt from cross shaft angle and remove this angle.

ORDNANCE MAINTENANCE – POWER TRAIN, SUSPENSION, AND EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4

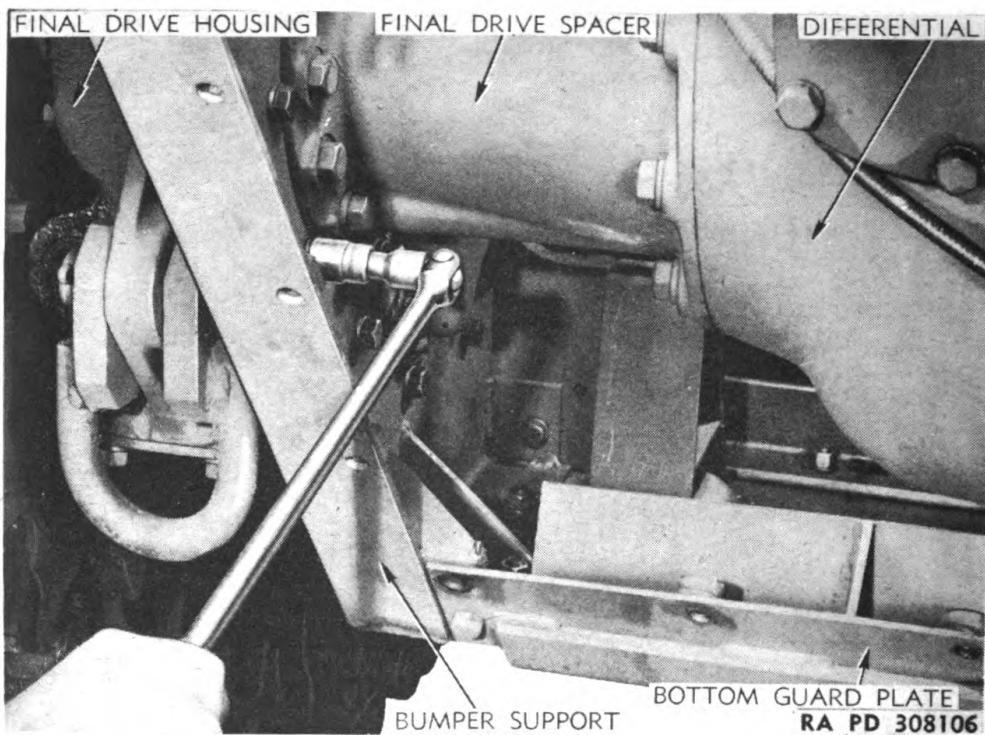


Figure 6 – Disconnecting Bumper Supports From Final Drive Housing

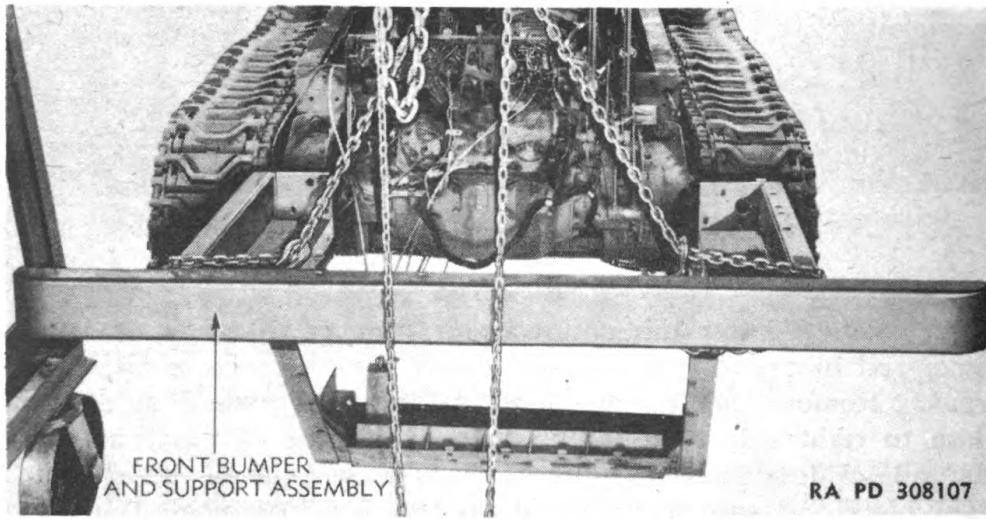


Figure 7 – Front Bumper and Support Assembly Removed

c. Remove Front Bumper and Support Assemblies. Remove yoke pin from winch control rod and lever on left fender (fig. 5). Remove clutch pedal stop by removing the two attaching bolts. Remove the six bolts attaching front bumper supports to front posts of hull. Remove two cap screws from lower ends of bumper

POWER TRAIN (LESS TORQUE CONVERTER)

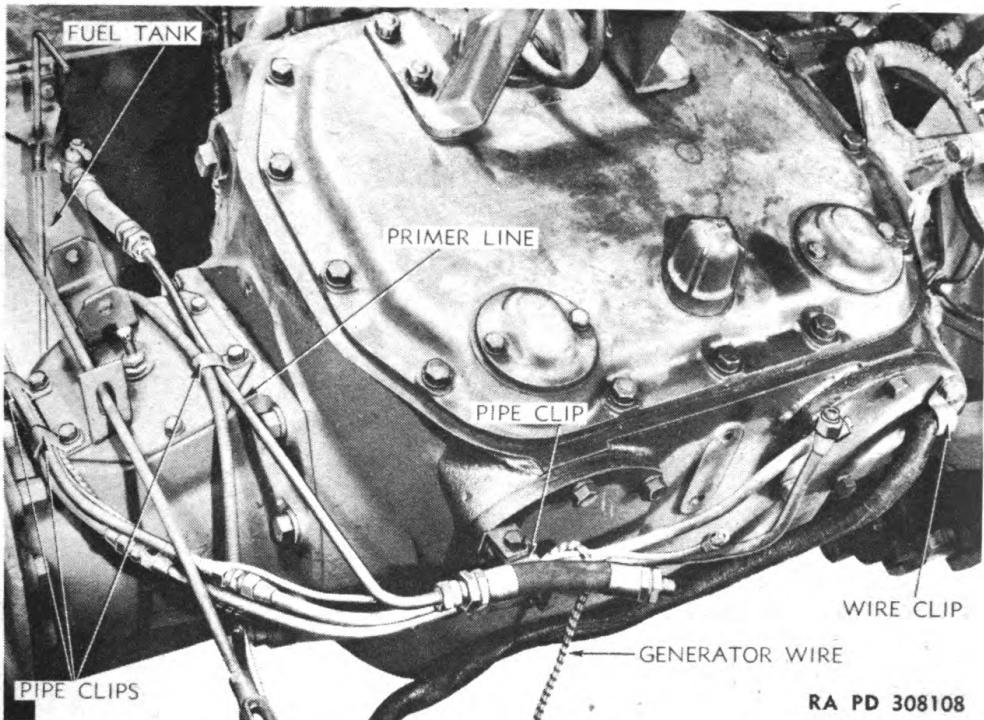


Figure 8 — Location of Wires, Pipes, and Clips on Differential and Final Drive Cases

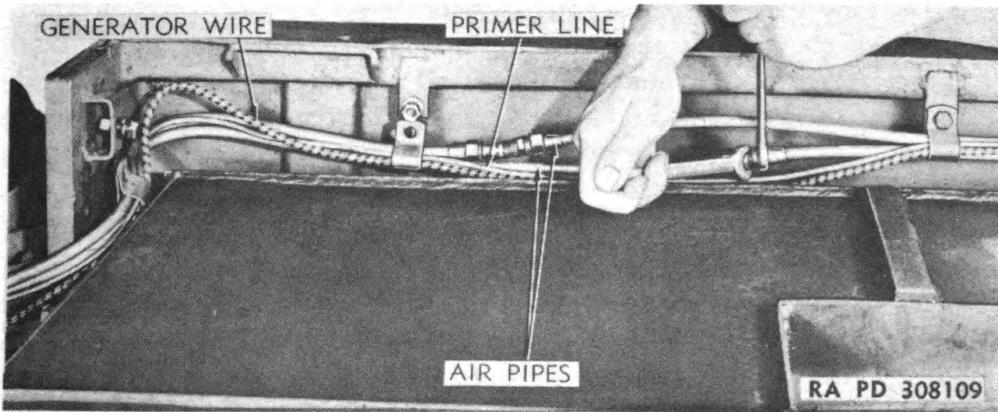
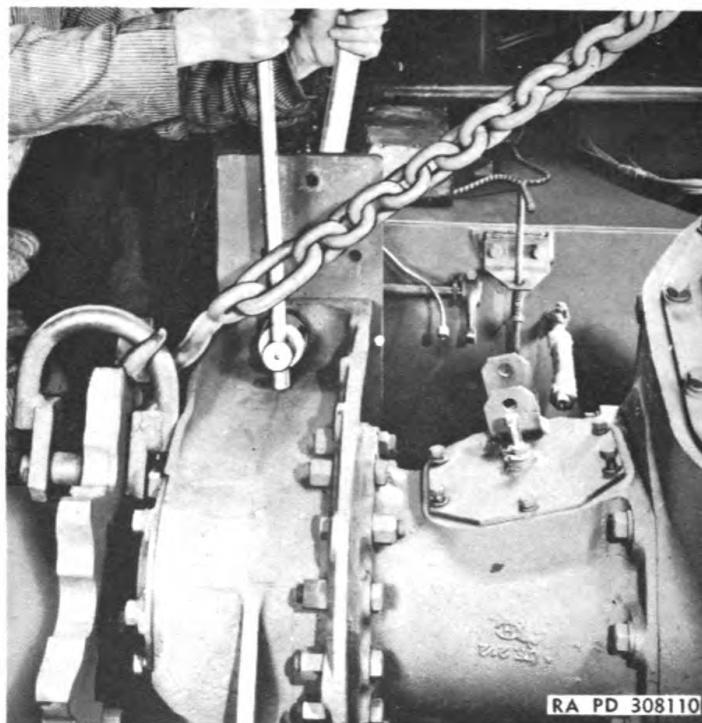


Figure 9 — Disconnecting Air Lines

supports and front hull posts by working through opening made by removal of front guard plate. Remove cap screws attaching sides of bumper supports to final drive housings (fig. 6). Attach hoist with chain (fig. 7) to support weight of assembly, then remove the seven bolts holding bottom guard plate to bottom of hull and remove the bumper and bumper support assembly from tractor.

d. Remove Differential, Transmission, and Final Drive Assembly. Uncouple tracks. Remove cap screws from clips holding wires and lines to differential case and final drive spacers (fig. 8). Discon-

ORDNANCE MAINTENANCE – POWER TRAIN, SUSPENSION, AND EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4**Figure 10 – Removing Upper Attaching Bolts**

nect generator wire from terminal of ammeter and remove it from clips on instrument panel. Disconnect larger engine primer line from front of fuel tank and remove line. Disconnect air lines inside hull back of front hull post (fig. 9). Disconnect smaller engine primer line near front post of hull and lay pipes back on fuel tank. Place instrument panel under front of tractor in such a manner that instruments are protected from damage. Remove bolts from first two clips inside hull holding air lines, small primer line, and generator wire to hull on right side and lay wire and lines back on fuel tank. Remove bolt from wiring harness clip on left front hull post. Disconnect transmission vent line from fitting at top of power take-off. Disconnect wires from transmission oil pressure and temperature gage operating units on transmission oil supply manifold (fig. 13). Disconnect front converter bearing lubricating oil line from fitting on converter. Disconnect large discharge oil line from rear of transmission oil supply manifold. Remove shear pin from front winch propeller shaft universal and power take-off shaft, and the two bolts from center winch propeller shaft bearing to allow universal to be forced from power take-off shaft. Remove nuts from studs attaching converter to adapter at rear of transmission. Remove two cap screws connecting transmission oil return line to differential oil manifold at rear of differential case. Remove the two towing

POWER TRAIN (LESS TORQUE CONVERTER)

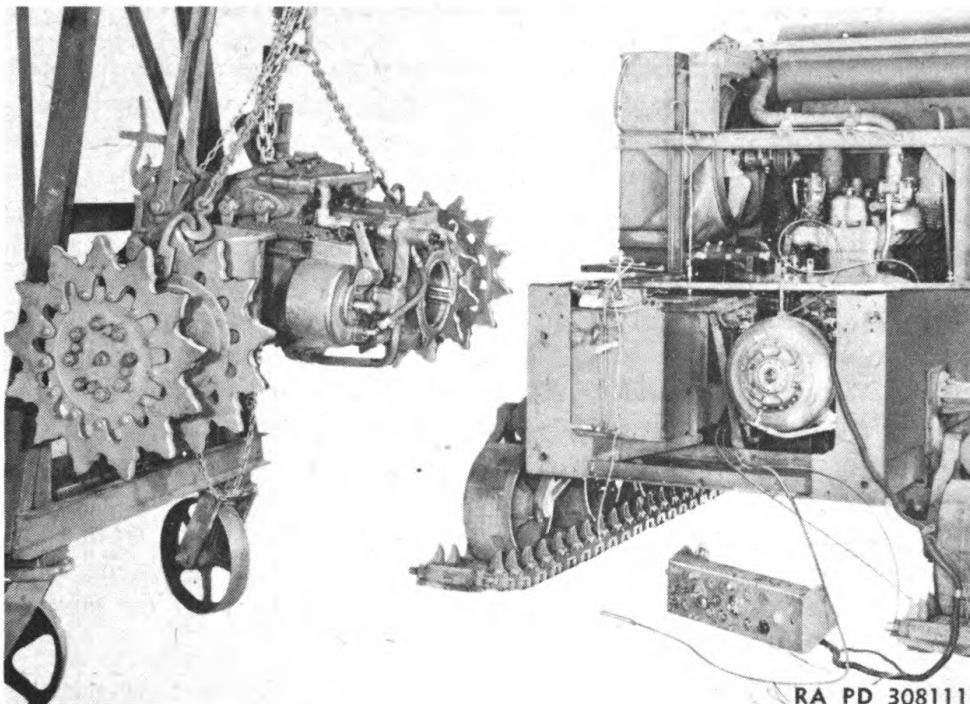


Figure 11 — Transmission, Differential, and Final Drive Assembly Removed

clevises from rear of hull and with these clevises and lifter chain on inside sprockets (fig. 10), support weight of unit on chain hoist. Remove the two lower cap screws attaching final drive housings to front hull post. Remove bolt from clip on transmission oil return line attached to torque converter. Disconnect transmission vent line at left front corner of engine and slide line back out of way. Reach through opening over winch at rear of hull and remove pin from winch clutch control rod and lever. Push control rod back through hole on front corner post of hull. Engage steering brakes tightly and lock levers. Remove the two large bolts attaching tops of final drive housings to top of hull posts (fig. 10) and maneuver assembly up and out of hull (fig. 11).

Section III

INSTALLATION

8. INSTALLATION OF TRANSMISSION, DIFFERENTIAL, AND FINAL DRIVE ASSEMBLY.

a. **Install Assembly on Hull.** Cement new gasket on attaching flange of torque converter. Pull steering levers back tightly and

ORDNANCE MAINTENANCE – POWER TRAIN, SUSPENSION, AND EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4

lock levers. Attach lifting chain and towing clevises to drive sprockets (fig. 10). Lift assembly with hoist high enough for power take-off to clear front post of hull and move assembly into position over tractor. Lower assembly into place with front post of hull between power take-off case and final drive spacer, keeping right end of assembly swung outward to permit transmission input shaft to clear converter attaching flange. After assembly has been lowered far enough, push assembly in to insert input shaft into splined hub of converter and align holes for attaching bolts in end of hull and final drive housings. Install the two large bolts with lock washers at upper end of hull posts (fig. 10) and the two cap screws with lock washers at lower end of posts, tightening them securely after all four have been installed. Remove lifting chain from sprockets. Install nuts and lock washers on studs in converter to attach transmission to torque converter. Attach clip on loom, containing wires leading to converter pressure and temperature gages, to stud on converter nearest transmission oil supply manifold.

b. Connect Controls, Pipes, and Wires. Connect transmission vent pipe to fittings on top of power take-off and vent tube at bottom of radiator supporting frame. Pull winch clutch control rod forward through hole in front post of hull. Connect rear end of rod to clutch lever on winch with yoke pin and secure pin with cotter pin. Using new gasket, connect transmission oil return pipe to oil manifold on rear of differential case (fig. 13) with two cap screws and lock washers. Install bolt with lock washer to attach clip supporting rear end of this pipe to bracket on converter. Slip front winch propeller shaft universal onto power take-off shaft, line up holes, and install shear pin through both. Secure with cotter pin. Attach center bearing on winch propeller shaft to side of hull with two bolts and lock washers. Connect large transmission oil discharge line to rear of transmission oil supply manifold. Connect converter bearing lubricating oil line (fig. 13) to fitting on converter. Connect wires to terminals of transmission oil pressure and temperature operating units on oil supply manifold. Connect clip on wiring harness to inside of front hull post with bolt and lock washer (fig. 9). Connect air pipes and smaller primer line pipe and secure these pipes and generator wire with clips and bolts to the first two brackets inside hull (fig. 9). Connect larger primer line pipe to fitting on fuel tank. Attach clips on pipes and wires to differential case and final drive spacer (fig. 8).

c. Install Front Bumper and Support Assembly. Lift assembly with chain hoist and maneuver it into position over final drive spacers (fig. 7), at same time entering winch clutch rod through hole in bumper support. Install three bolts to attach each bumper support

POWER TRAIN (LESS TORQUE CONVERTER)

to upper end of front post of hull. Do not tighten these bolts as all bolts and cap screws must be installed before any are tightened. Use lock washers on all bolts and cap screws. Install seven bolts to attach bottom plate to front bottom rail of hull. These seven bolts are to be installed from the bottom with nuts and lock washers inside the hull. Install cap screws to attach bumper supports to final drive housings (fig. 6). Install two cap screws in bottom of supports and bottom of front hull posts. Tighten all bolts and remove chain hoist. Install clutch pedal stop with two bolts with lock washers. Connect winch control rod to lever on left fender with yoke pin and cotter pin.

d. Install Front Floor Plate. Place throttle cross shaft angle in place over front edge of differential housing and attach to housing with two cap screws with lock washers, attaching bracket to front of differential case, and one bolt with lock washer in right end of angle. Connect throttle control rod at right end of cross shaft to lever on shaft with yoke pin and cotter pin. Place front floor plate over throttle cross shaft. Use lock washers on all cap screws and attach floor plate to cross shaft angle with three cap screws and to bumper with two cap screws. Install hull drain valve lever on rear end of valve crank in bracket on final drive spacer. Slip upper rod block of valve rod onto other end of crank and install washer and cotter pin. With linkage connected and valve closed, move lever toward differential housing until it just clears rear edge of floor plate, then tighten clamp screw in lever. Valve will now operate properly.

e. Install Cab and Connect Throttle Linkage. Follow procedure outlined in paragraph 5 to install cab, then connect hand throttle rod and accelerator pedal link to levers on throttle cross shaft.

f. Connect Tracks. Make sure oil in all compartments is at proper level. Connect and adjust tracks, then operate tractor to check adjustment of all controls and operation of power train components.

**ORDNANCE MAINTENANCE – POWER TRAIN, SUSPENSION, AND
EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4**

CHAPTER 4
TRANSMISSION AND DIFFERENTIAL
Section I
DESCRIPTION

9. GENERAL.

a. Although the transmission and differential are separate assemblies, their design and assembly are so closely related that their operation and repair must be considered together. The rebuilding of either unit requires the adjustment of one to the other when reassembling. The power take-off assembly is also closely related to the transmission and differential due to the fact that all three assemblies are connected and lubricated by a common oil supply and circulating lubrication system. An oil pump (par. 22), mounted on the power take-off, circulates the oil to the oil cooling radiator and supplies oil to gears and bearings not adequately lubricated by the distribution of oil by the gears.

10. CONSTRUCTION AND OPERATION.

a. **General.** The differential assembly is centrally located in the power train. The final drives are bolted to each side of the differential case and the transmission case connects to the rear of the differential case. The power take-off assembly is mounted on left side of transmission case and the speedometer drive housing is attached to the case at end of bevel pinion shaft.

b. Transmission.

(1) The transmission is of the selective-type, providing three forward speed ranges: creeper, low, and high, and one reverse. Figure 12 is a horizontal cross section of the transmission assembly showing gears in neutral position. All the gears are splined and turn with the shafts with the exception of the high range gear, overrunning clutch gear, and reverse idler gear. These are floating gears. The overrunning clutch assembly consists of a cam and roller assembly with a gear attached to the cam. Its purpose is to compensate for the different gear ratios involved in the constant mesh low and high range gears.

(2) By following the lines of the drawing, the relative position of the gears and flow of power through the transmission in all the speed ranges can easily be traced. The selection of the speed range desired is accomplished by engaging one of three sliding gears with another gear by use of the gearshift lever. The creeper pinion,

TRANSMISSION AND DIFFERENTIAL

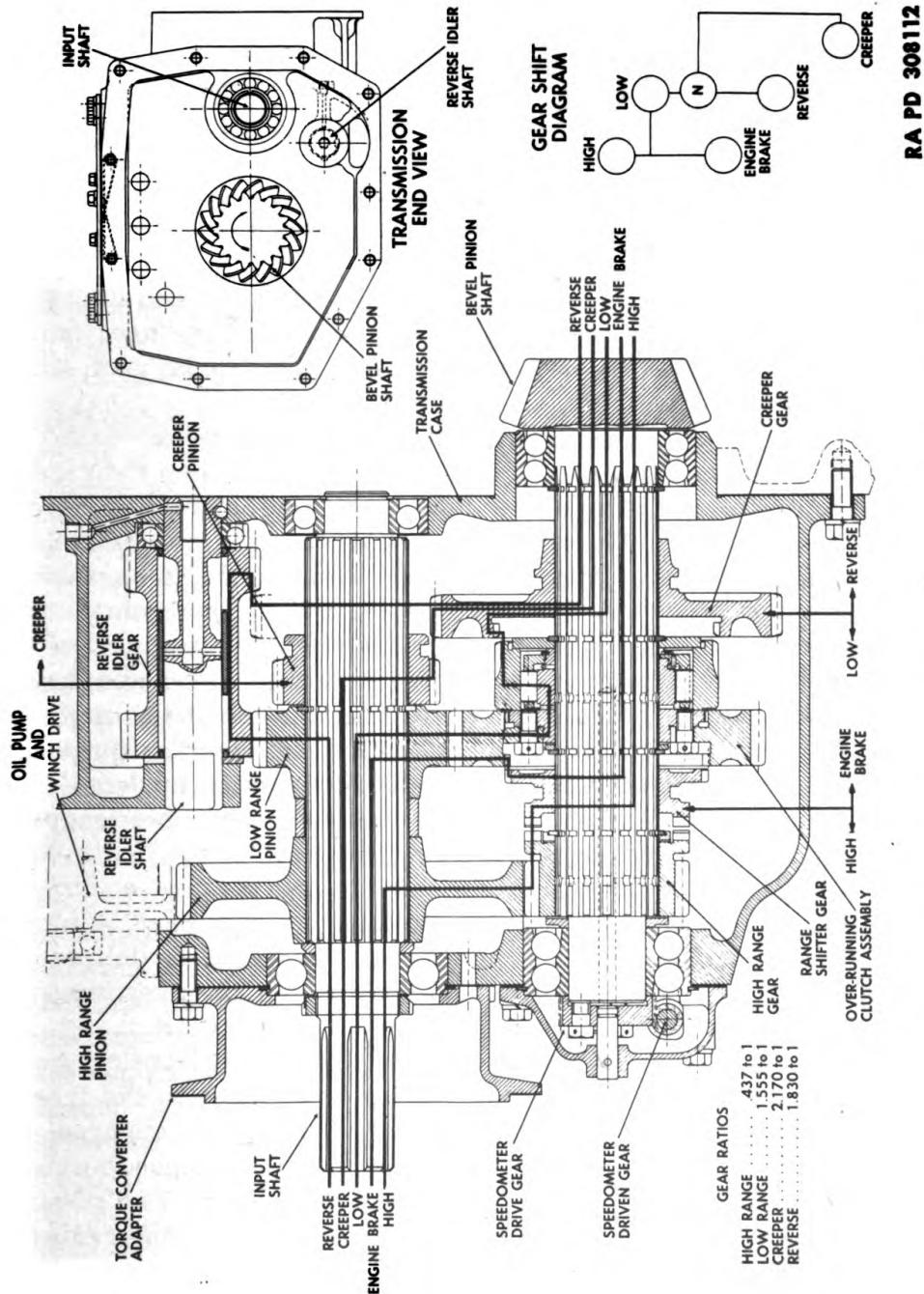


Figure 12 — Cross Section of Transmission Assembly

ORDNANCE MAINTENANCE – POWER TRAIN, SUSPENSION, AND EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4

creeper gear, and range shifter gear are the only sliding gears. Only one sliding gear is engaged in any speed range.

(a) *Creeper Range.* For this speed range the creeper pinion is engaged with the creeper gear and the power flows from the input shaft through the creeper pinion and creeper gear to the bevel pinion shaft.

(b) *Low Range.* The internal teeth of the creeper gear are engaged with the splines on outer race of the overrunning clutch. Power then flows from the input shaft through the low range pinion to the overrunning clutch gear. The power is then transferred through the overrunning clutch cam and roller assembly to the creeper gear and to the bevel pinion shaft.

(c) *High Range.* The range shifter gear moves back and engages with teeth on side of the high range gear. Power then flows from the input shaft through the high range pinion, high range gear, and range shifter gear to the bevel pinion shaft.

(d) *Reverse.* The creeper gear is engaged with the gear teeth on front end of reverse idler gear. The flow of power is then delivered from the input shaft through the low range pinion, reverse idler gear, and creeper gear to the bevel pinion shaft. The reverse idler gear assembly is located below the input and bevel pinion shafts but on the drawing is shown to one side for better illustration.

(e) *Engine Brake.* The gearshift lever is moved to engine brake position when descending long steep hills and it is desired to hold tractor to a low speed by utilizing the braking power of the engine. The lever would normally be shifted to low position for this purpose but due to the free-wheeling action of the overrunning clutch in low gear, no braking effect would be obtained. Shifting into engine brake position slides the range shifter gear into mesh with the internal teeth of overrunning clutch gear thus making a direct connection between the overrunning clutch gear and bevel pinion shaft. In this way the braking power of the engine is delivered from the input shaft through the low range pinion, overrunning clutch gear, and range shifter gear to the bevel pinion shaft.

(3) The bevel pinion extends into the differential housing and engages the bevel gear. The torque converter attaches to the front of the transmission case and the transmission input shaft engages in the splined hub of the converter turbine wheel. The speedometer is driven by a worm gear on end of bevel pinion shaft. The power take-off assembly is driven by a gear on the transmission input shaft.

c. *Differential.* The controlled differential is the same type as that used in the light tanks. It is contained in the differential case and mounted in roller bearings in ends of the case. Steering brake drums, brake bands, and lever controls provide for steering the tractor.

TRANSMISSION AND DIFFERENTIAL

11. LUBRICATION.

a. Oil is carried at a specified level in the differential and transmission cases. This oil is distributed to most of the gears and bearings by the rotation of the gears. Further distribution and circulation of the oil is effected by the transmission oil pump driven by the power take-off. This pump draws oil from a sump in bottom of the differential case and delivers it, through various lines connected to a supply manifold above pump, to bearings in the power take-off, speedometer drive, torque converter, and differential. The pump also circulates the oil through a cooling radiator in the radiator assembly where it is cooled before it is returned to a distribution manifold on the differential case, thus preventing excessive oil temperatures

Section II

DISASSEMBLY OF TRANSMISSION AND DIFFERENTIAL

12. GENERAL.

a. Due to the final drives being attached to the differential case, these assemblies must be removed before the differential and transmission can be disassembled. This requires the use of a hoist and proper platform of blocks that will support the entire assembly while these units are removed. A fairly large area of floor space and plenty of clean benches and parts trays will be needed to accommodate all the parts removed. Cleanliness is of extreme importance and care must be exercised to keep dirt and foreign matter away from the parts as they are removed, especially in regard to bearings. Provide drain pans and a good supply of wiping cloths.

b. Complete disassembly of the transmission and differential and their subassemblies is outlined in the following paragraphs. It will not always be necessary to make a complete disassembly to replace or repair broken parts. Remove only those subassemblies which must necessarily be removed to replace damaged parts and to allow complete inspection of the remaining parts. Inspect each part or subassembly for wear or damage as it is removed and make a list of repair parts that will be needed to reassemble unit.

13. DISASSEMBLY INTO SUBASSEMBLIES.

a. **Scope of Paragraph.** This paragraph outlines the separation of the final drives, power take-off, transmission, and differential assemblies after they have been removed from the tractor as one unit.

b. **Drain Oil From Cases and Mount Assembly on Blocks.** With assembly suspended above floor with hoist, remove drain plugs from differential oil sump and final drive cases and drain oil into containers.

ORDNANCE MAINTENANCE – POWER TRAIN, SUSPENSION, AND EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4

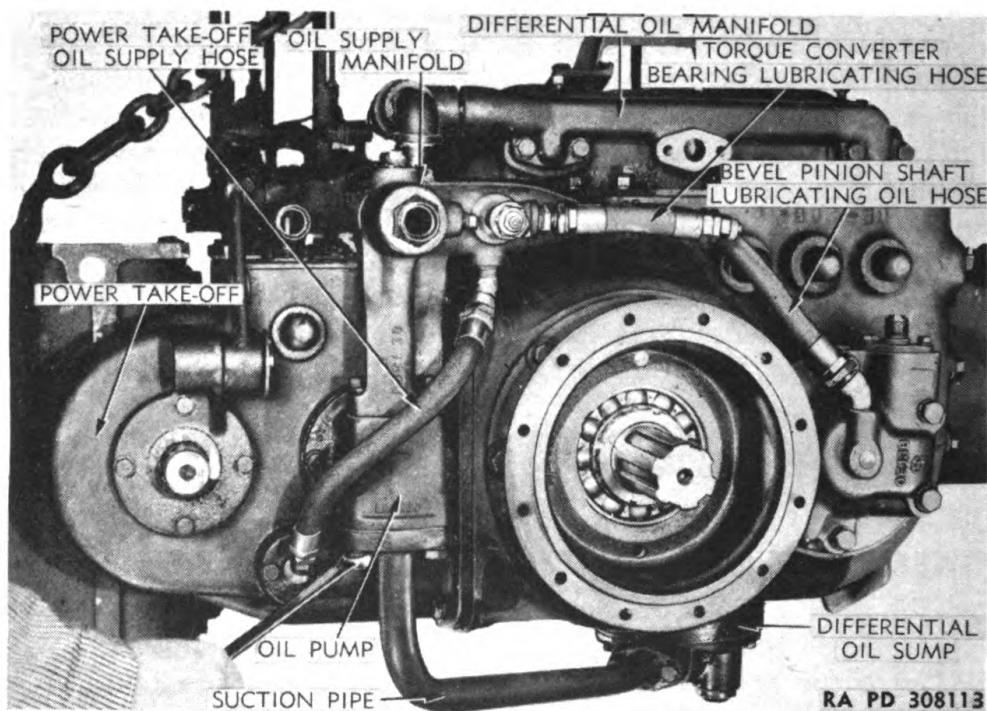


Figure 13 – Removing Oil Pump Suction Pipe

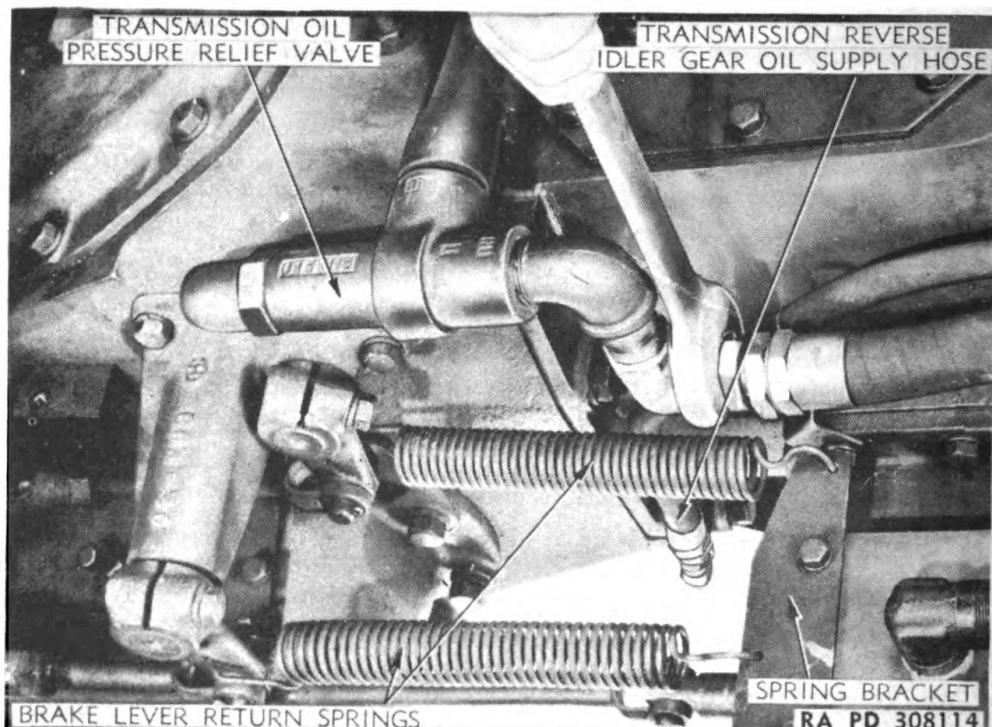


Figure 14 – Disconnecting Oil Pressure Relief Valve Inlet Hose

TRANSMISSION AND DIFFERENTIAL

Remove four cap screws attaching oil pump suction pipe to pump and oil sump and remove pipe (fig. 13). Remove eight cap screws and remove oil sump and screen from bottom of differential case (fig. 49). Lower assembly onto a platform or blocks built so that the entire assembly will be supported on these blocks by the differential case and sprockets will clear floor. Place wedges under differential case so assembly cannot tip sideways or roll forward or back. Remove hoist chain and hoist.

c. **Remove Power Take-off Assembly From Transmission** (figs. 13 and 14). Disconnect lower end of power take-off oil supply hose from power take-off. Disconnect oil inlet hose from lower pipe elbow at rear of oil pressure relief valve. Disconnect end of transmission bevel pinion shaft oil supply hose from oil supply manifold. Remove cap screw from clip on this hose. Disconnect transmission reverse idler gear oil supply hose from fitting on left side of transmission case at bottom and rear of case. Remove the two cap screws attaching oil supply manifold to oil pump and remove manifold with attached hoses. Unhook the two brake return springs from bracket on power take-off and levers and remove them. Remove yoke pin to disconnect control rod from power take-off shifter shaft, then remove the eight attaching cap screws and lift power take-off assembly from transmission case.

d. **Remove Final Drive Assemblies.** Slide clutch pedal off post on steering lever bracket. Remove yoke pins to disconnect rear ends of steering brake control rods from levers on control shafts. Remove the four cap screws attaching steering lever bracket to front of final drive spacer. Carefully pull lever assembly sideways to slide lever shaft out of steering lever and clutch pedal support (fig. 15) so that stop light switches will not be damaged in removing lever assembly. Remove nine cap screws that attach final drive spacer to differential case, then, using chain hoist as shown in figure 16 to support the weight, pull final drive and sprocket assembly sideways away from differential. Remove second final drive assembly in same manner.

e. **Remove Speedometer Drive Assembly and Converter Adapter** (fig. 17). Remove the six cap screws that attach speedometer drive housing to transmission case and remove drive assembly, pulling it straight from case. Remove the seven attaching cap screws from torque converter to transmission adapter and remove adapter. Remove steering brake lever quadrant from differential case after removing three cap screws.

f. **Remove Transmission From Differential** (figs. 17 and 18). Remove 4 cap screws attaching oil manifold to rear of differential case and lift manifold and oil pressure relief valve assembly from case. Remove 9 cap screws and lift off transmission cover. Unscrew

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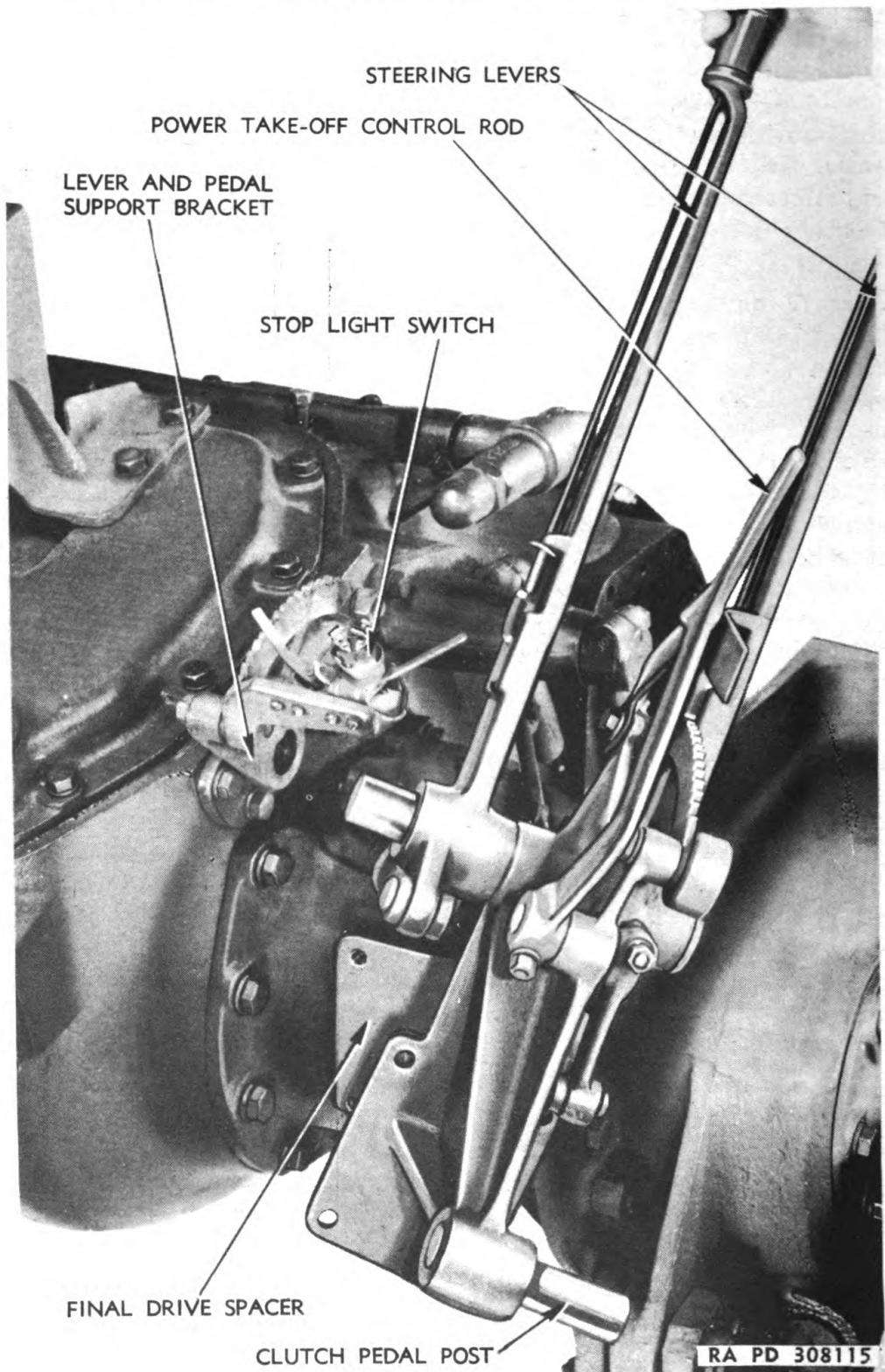


Figure 15 – Removing Steering Lever Assembly

TRANSMISSION AND DIFFERENTIAL

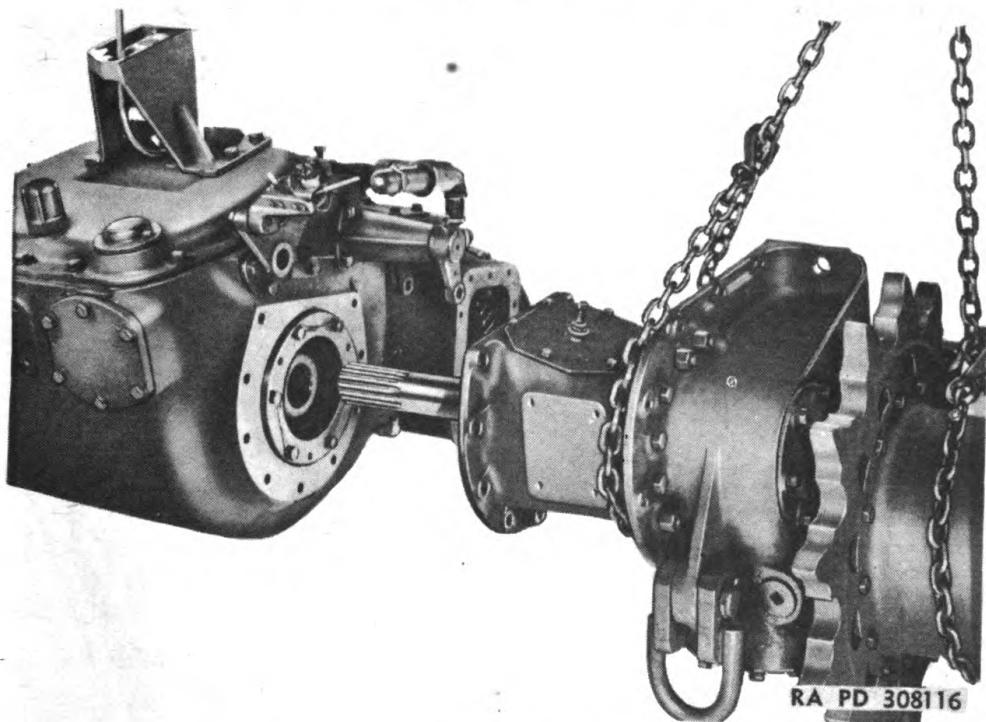


Figure 16 – Final Drive Removal

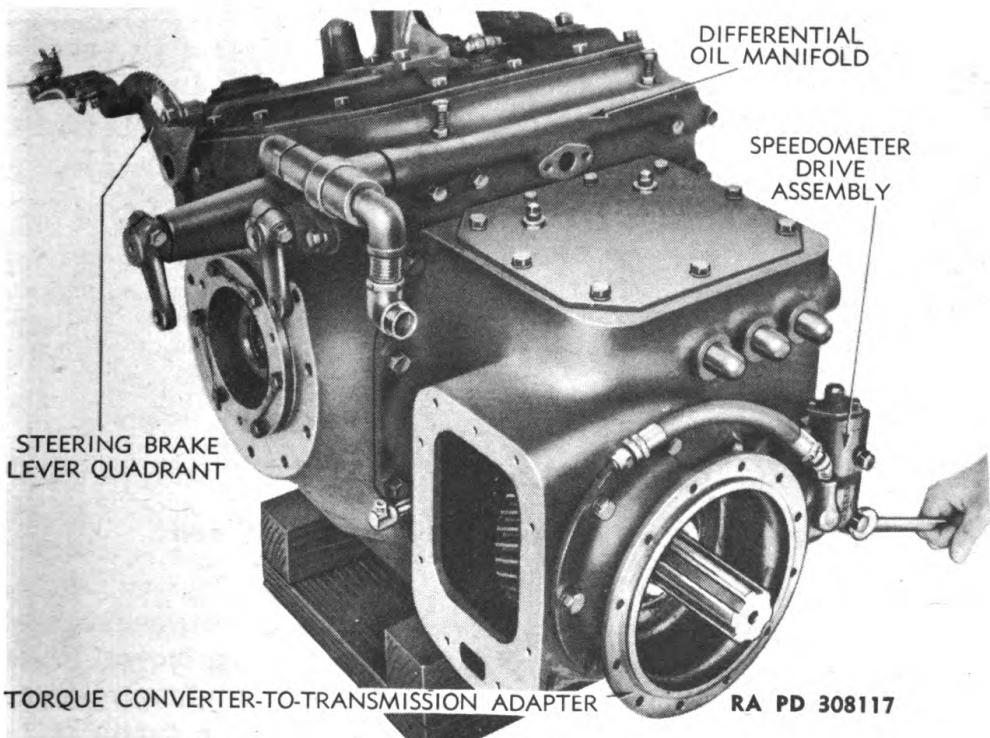


Figure 17 – Removing Speedometer Drive Assembly

ORDNANCE MAINTENANCE – POWER TRAIN, SUSPENSION, AND EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4

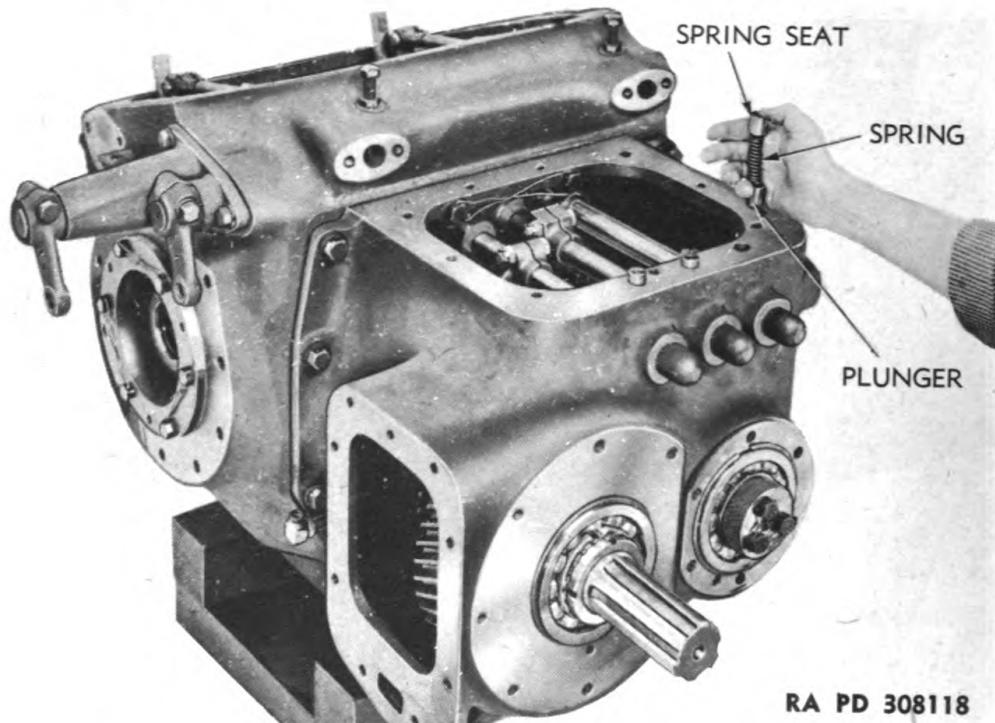


Figure 18 – Removing Shifter Shaft Spring Seats, Springs, and Plungers

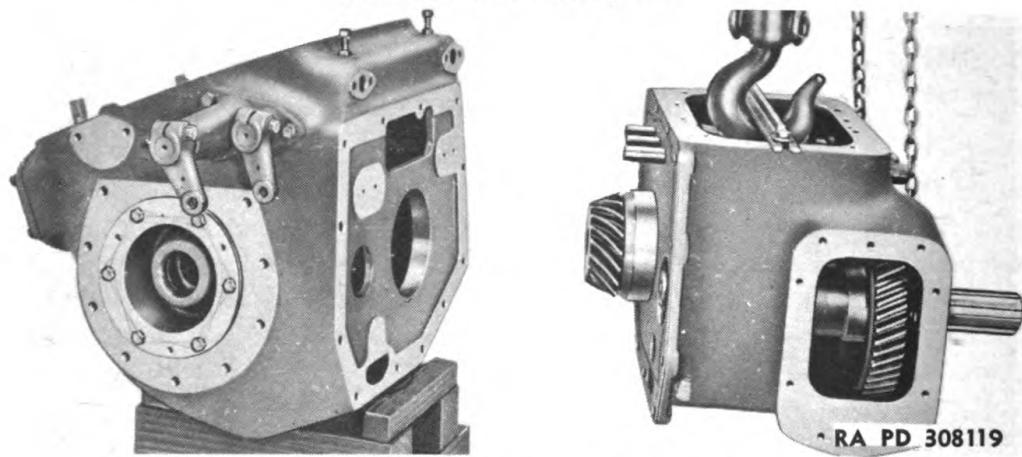


Figure 19 – Transmission Assembly Removed

oil level gage cover from differential and remove bayonet gage. Remove 14 cap screws and lift off differential housing cover. Lift the 3 shifter shaft spring seats, plunger springs, and plungers from transmission case. Pull cotter pins and loosen nuts on clamp bolts in shifter shaft extensions at front of shafts (fig. 65), then slide extensions off shafts. Cut and remove lock wire from the 2 cap screws

TRANSMISSION AND DIFFERENTIAL

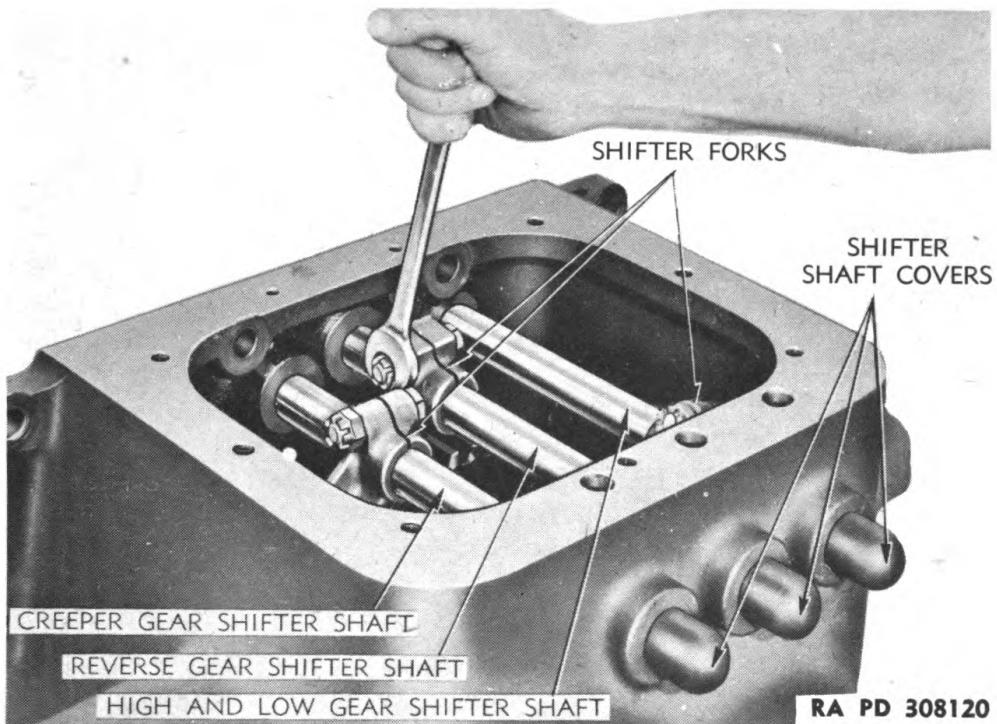


Figure 20 — Loosening Shifter Fork Clamp Bolts

above shifter shafts, then remove the 12 cap screws that attach transmission case to differential case. Take weight of transmission assembly on chain hoist, then pry transmission assembly from differential case and remove transmission assembly (fig. 19).

14. DISASSEMBLY OF TRANSMISSION.

a. **Remove Shifter Shafts and Forks** (fig. 20). Pull cotter pins and loosen nuts on shifter fork clamp bolts. Drive shifter shafts towards rear of case. This will push shifter covers out of case. Then slide shafts out of forks and case and remove forks. Remove the shifter shaft interlocking plungers and springs in lateral passages in front end of case (fig. 63).

b. **Remove Bevel Pinion Shaft and Gears.** Cut lock wire and remove the three cap screws from speedometer drive worm gear (fig. 21). Slip gear from end of shaft. Using puller (41-P-2905-60) mounted as shown in figure 22, press on bevel pinion shaft until it has been moved approximately three-fourths inch. Reach inside case and slide high range gear against rear of case. Slide splined washer toward high range gear. This will free a split lock ring so it can be removed from shaft (fig. 23). Push bevel pinion shaft nearly out of rear bearing hole in case. Slide range shifter gear into mesh with high range gear, then slide both against rear of case. Install the special remover and replacer (41-R-2378-59) under snap ring

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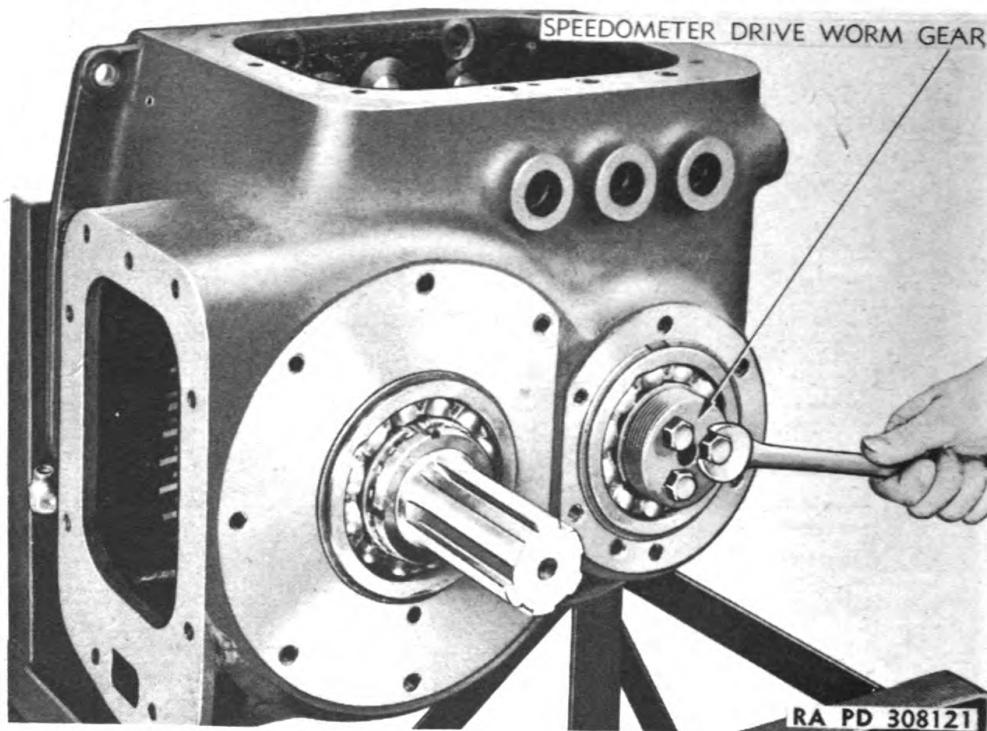


Figure 21 – Removing Speedometer Drive Worm Gear

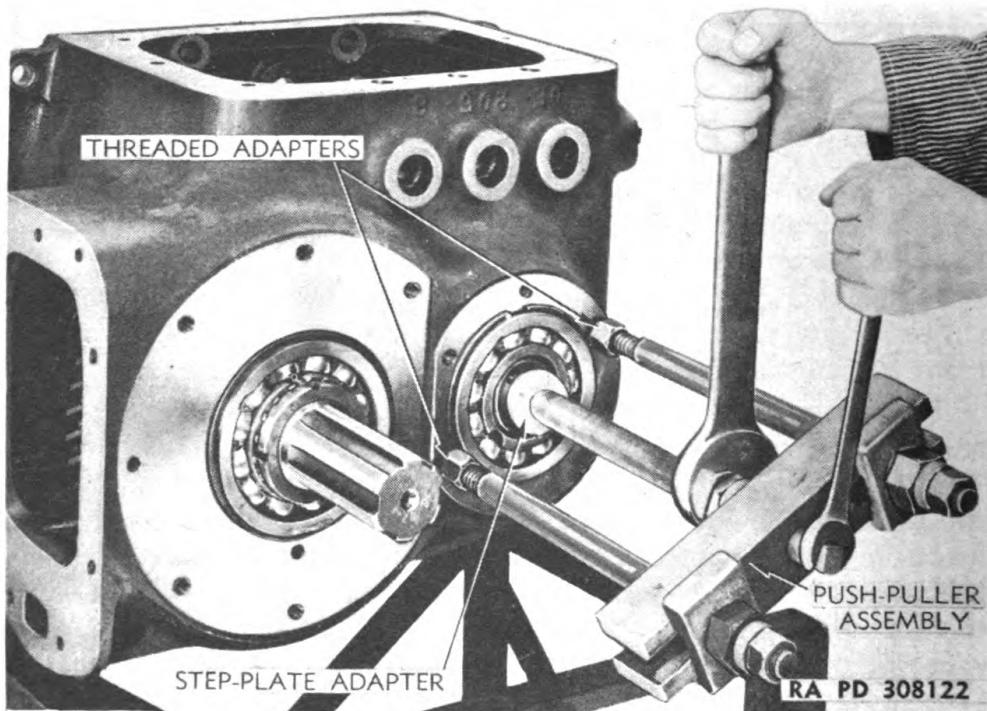


Figure 22 – Pressing Pinion Shaft Out of Housing, Using Puller (41-P-2905-60)

TRANSMISSION AND DIFFERENTIAL

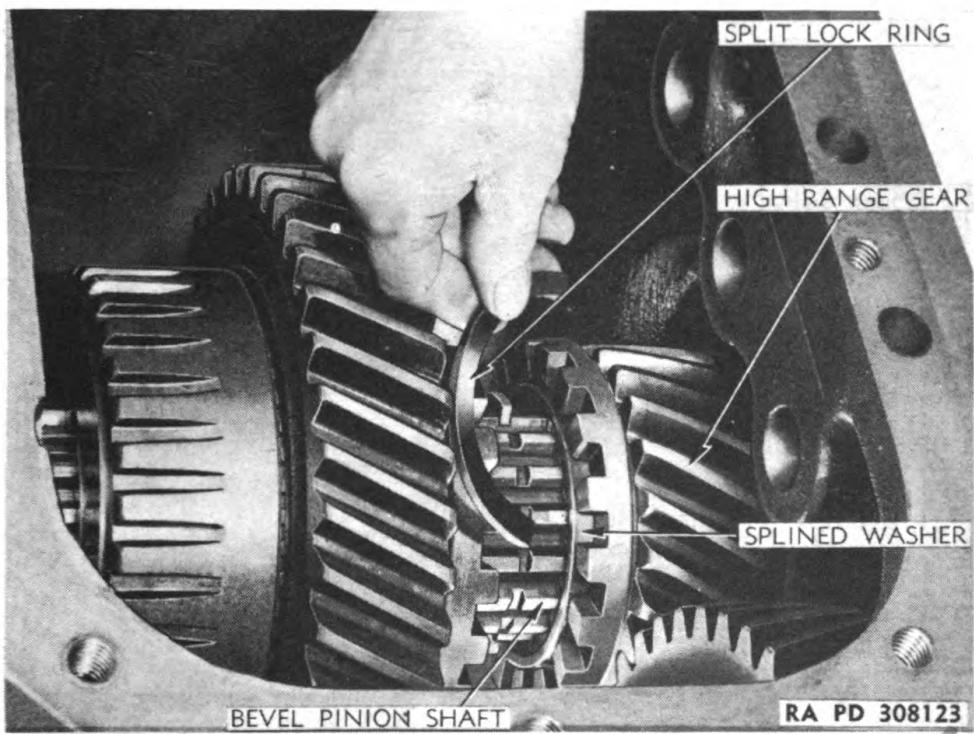


Figure 23 – Removing Pinion Shaft Snap Ring

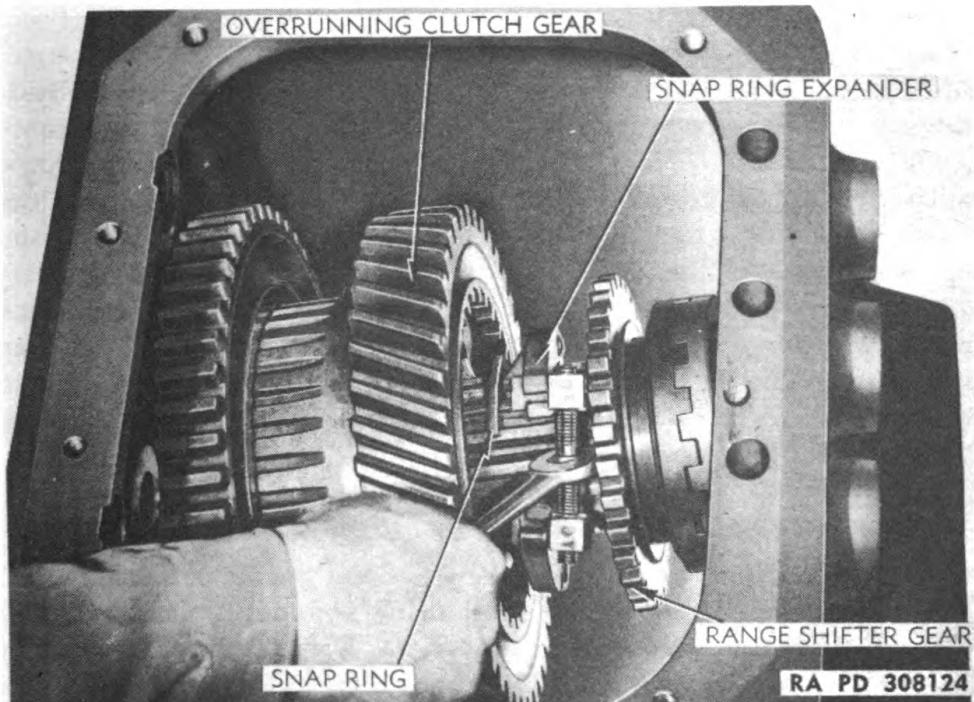


Figure 24 – Spreading Snap Ring, Using Spanner Wrench
(41-R-2378-59)

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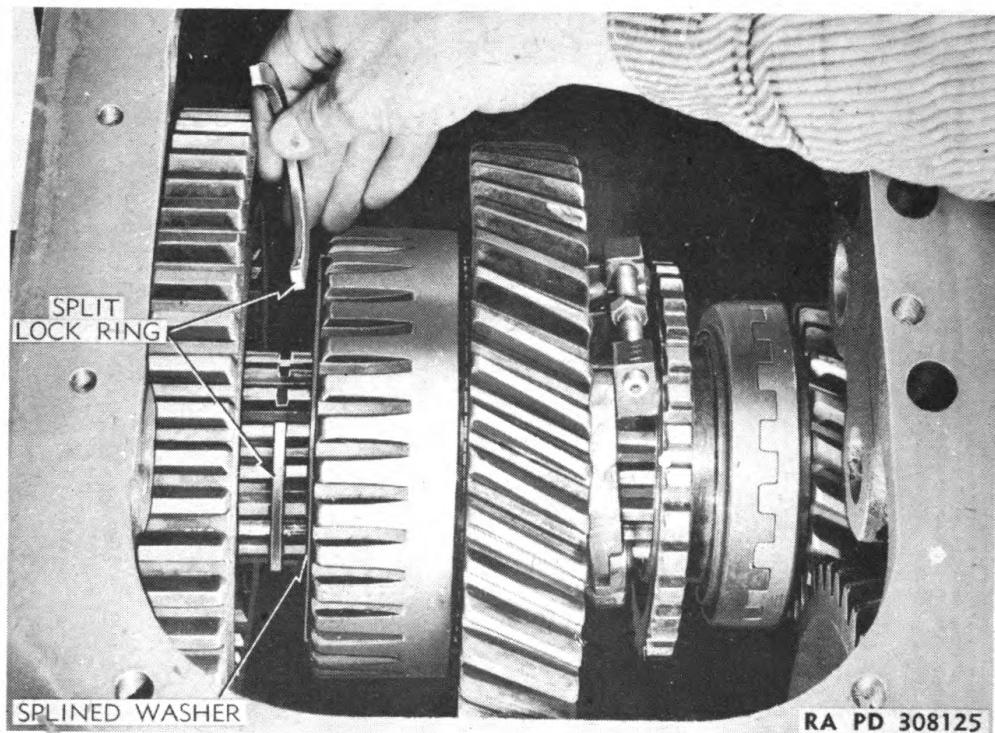
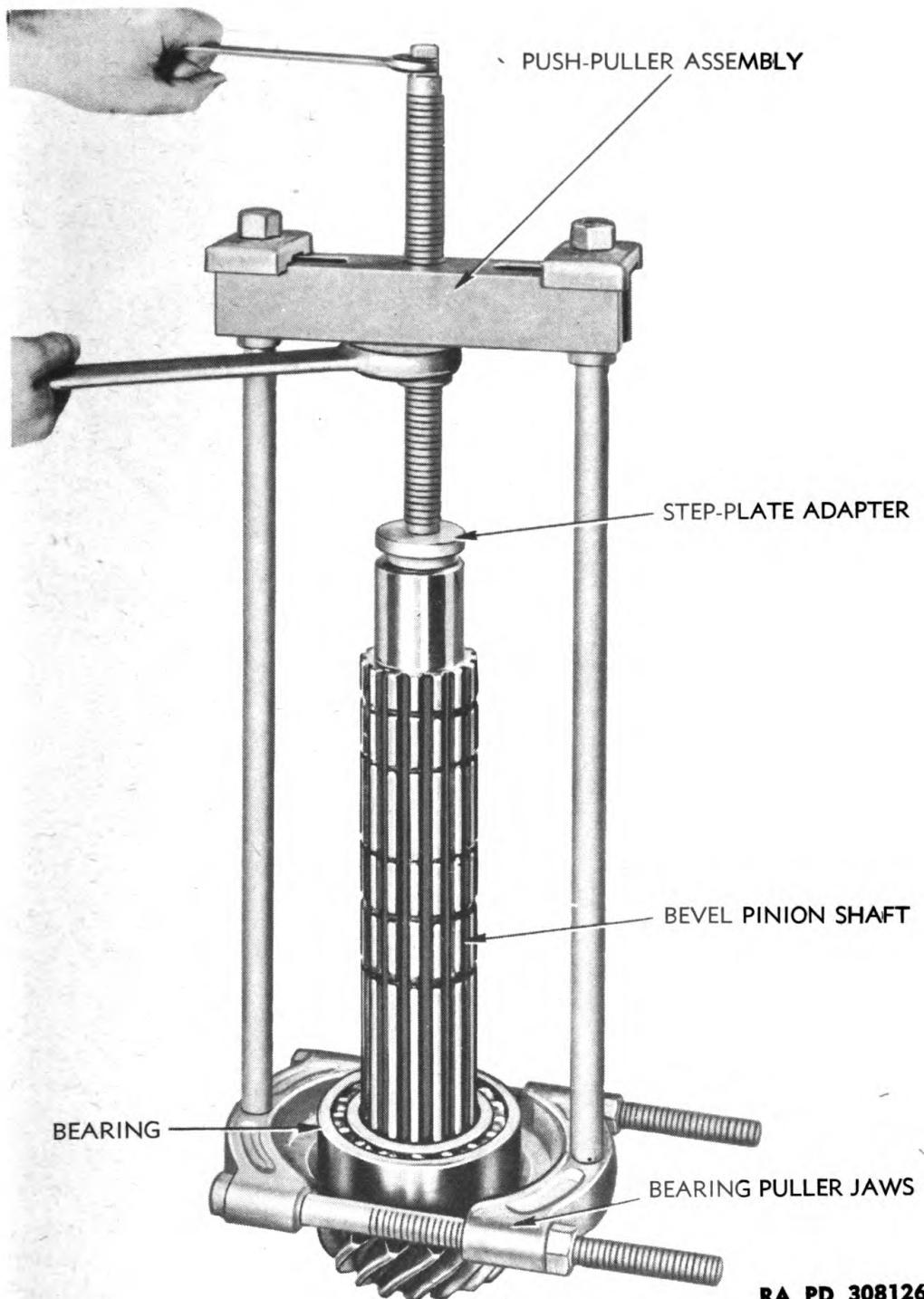


Figure 25 – Removing Second Pinion Shaft Snap Ring

in rear counterbore of overrunning clutch gear (fig. 24) and force snap ring out of groove in splines by turning expanding bolt. Slide assembly back against range shifter gear. Slide overrunning clutch assembly and splined washer back on shaft. Slide large splined washer at front of clutch toward clutch to free split lock ring and remove lock ring (fig. 25). Push shaft out of rear bearing and remove puller assembly. Then pull shaft out through front of case removing parts from shaft in following order: thrust washer, high range gear, range shifter gear, snap ring with expander, splined washer, overrunning clutch assembly, large splined washer, and creeper gear. After shaft is removed from case, remove snap ring from shaft with remover and replacer (41-R-2378-59) and pull bearing from shaft as shown in figure 26 using puller (41-P-2905-60). Drive rear bearing out of case. Tag shims for reassembly purposes.

c. Remove Input Shaft Assembly. Bend prong of lock washer out of slot in bearing lock nut and, using spanner wrench (41-W-3250-10) remove nut from shaft (fig. 27). Drive shaft toward front of case until front bearing is out of case. This will free the split lock ring in counterbore of low range pinion and lock ring can be removed. Then drive shaft on out of rear bearing and remove shaft with front bearing from front of case. Remove thrust washer, high range pinion,

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**Figure 26 – Removing Front Pinion Shaft Bearing,
Using Puller (41-P-2905-60)**

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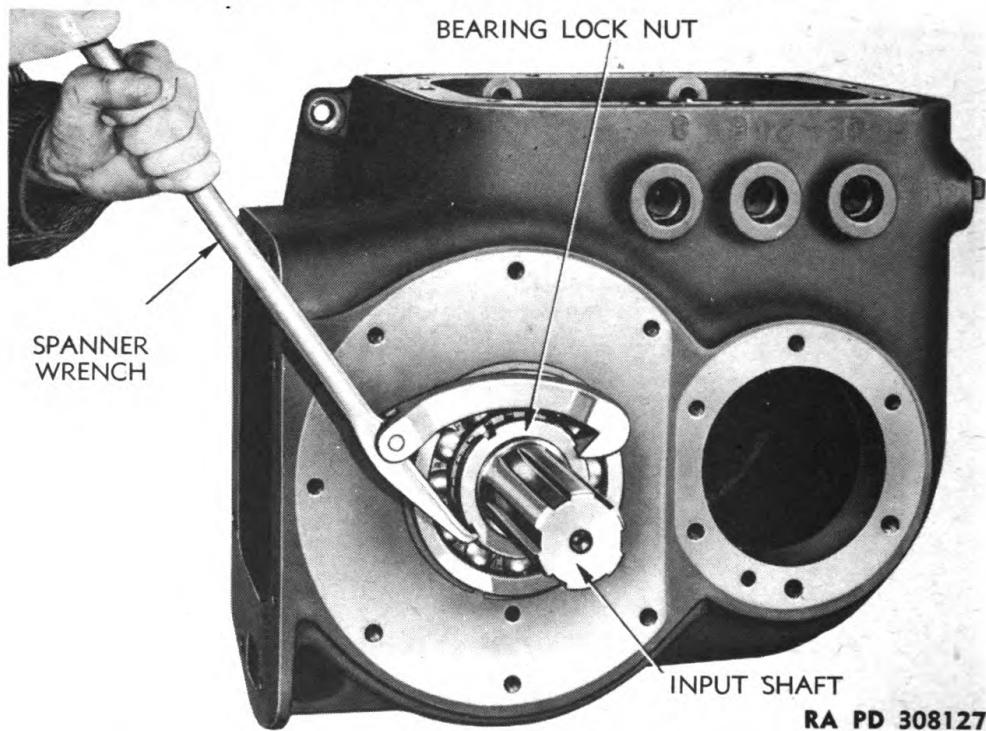


Figure 27 – Removing Lock Nut From Input Shaft, Using Spanner Wrench (41-W-3250-10)

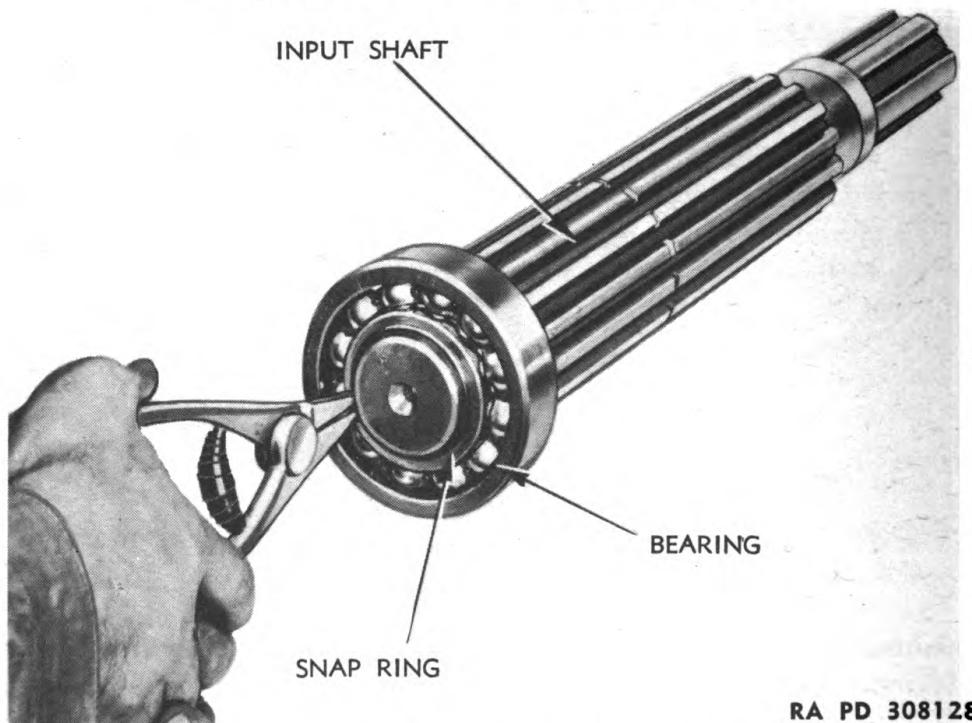
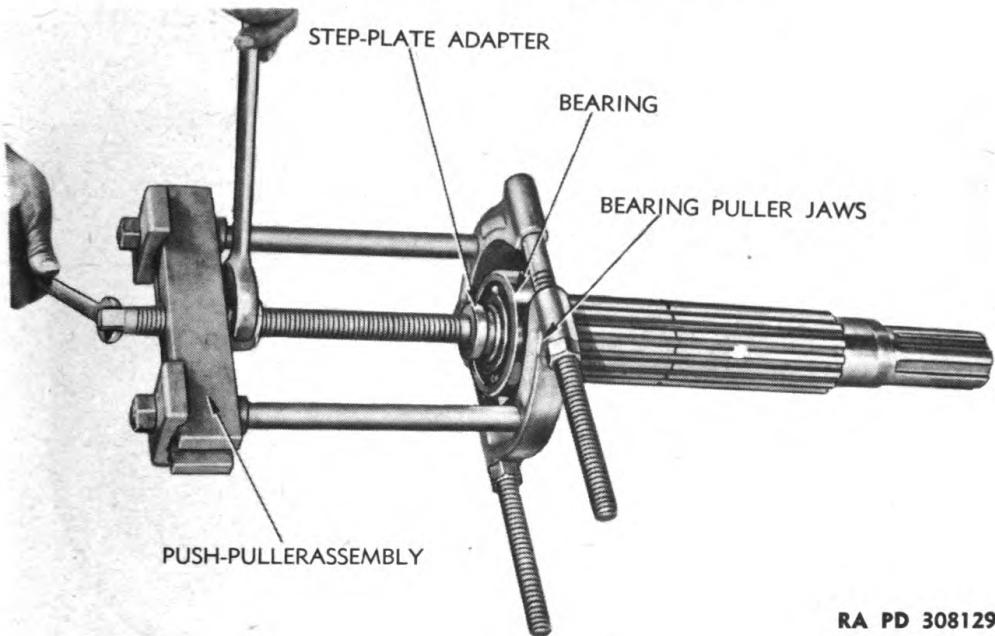
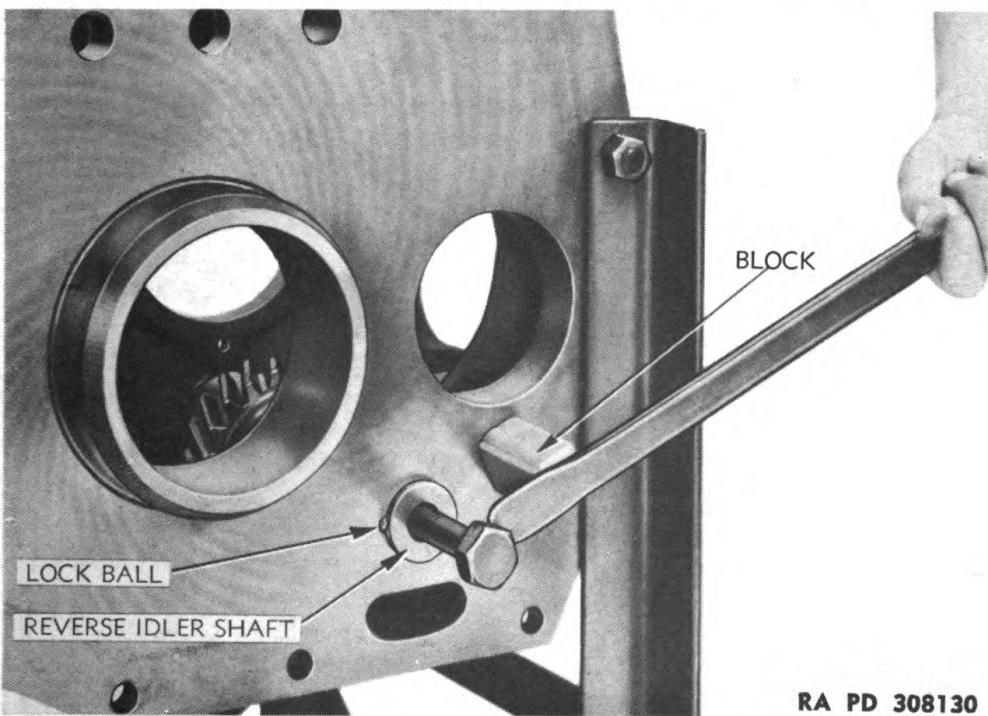


Figure 28 – Removing Snap Ring From Input Shaft, Using Pliers (41-P-1572)

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Figure 29 – Removing Front Input Shaft Bearing

RA PD 308130

Figure 30 – Pulling Idler Gear Shaft

transmission pinion spacer, low range pinion, and creeper pinion from shaft as shaft is removed. Remove snap ring from front end of shaft (fig. 28), then install push puller and bearing puller (fig. 29) and remove bearing from shaft. Tap input shaft rear bearing from case with soft hammer.

ORDNANCE MAINTENANCE – POWER TRAIN, SUSPENSION, AND EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4

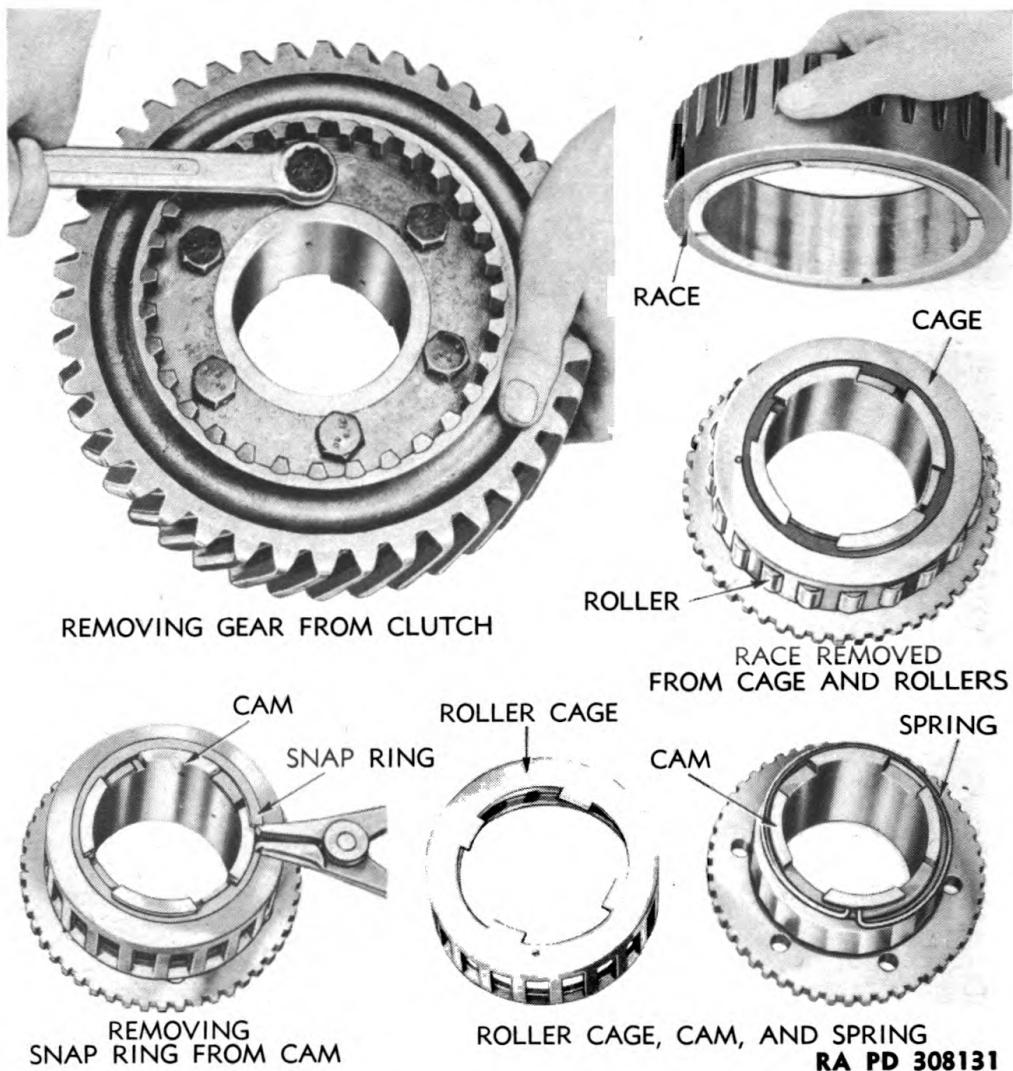


Figure 31 – Disassembly of Overrunning Clutch Assembly

d. Remove Transmission Reverse Idler Shaft Assembly (fig. 30). Install $\frac{3}{4}$ -inch NC cap screw into end of transmission reverse idler shaft and, using small bar and block (fig. 30), pry outward on shaft. This will release lock ball in outer end of shaft. As shaft is pulled on out of case, remove thrust washer, reverse idler gear, and reverse idler gear bearing. Drive or press bushings from gear if worn or replacement is necessary. **NOTE: On tractors with serial numbers M4-251 and above, the reverse idler gear is equipped with needle roller bearings instead of bronze bushings.**

e. Disassemble Overrunning Clutch Assembly (fig. 31). Lay assembly on bench with gear up. Cut lock wire, remove the six attaching cap screws and left off gear. Turn assembly over and lift

TRANSMISSION AND DIFFERENTIAL

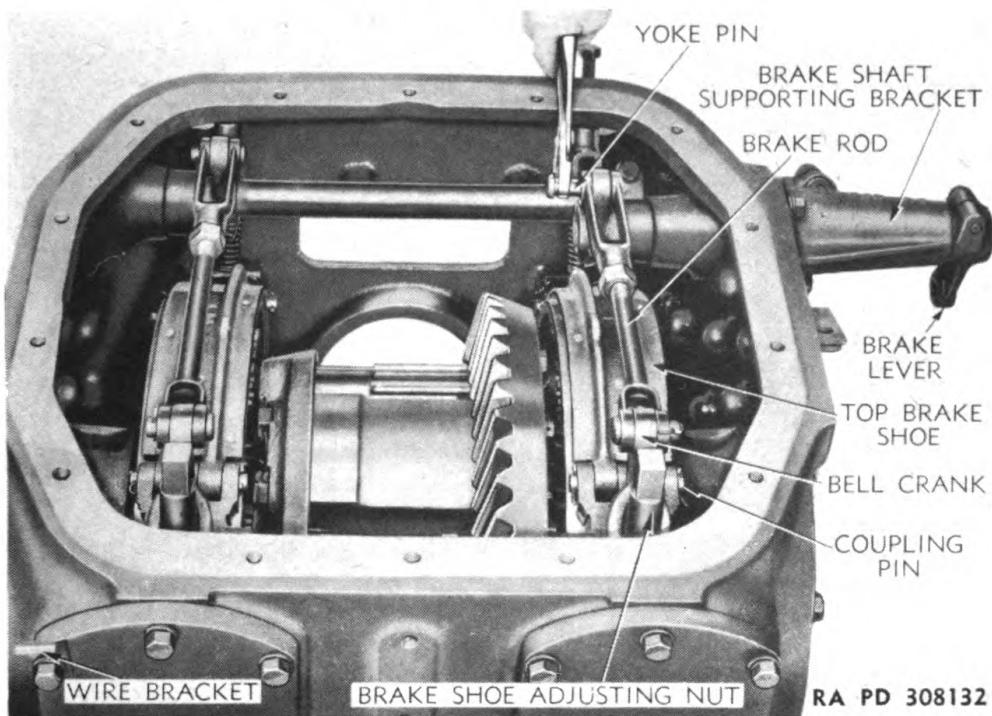


Figure 32 — Disconnecting Steering Brake Rod From Lever

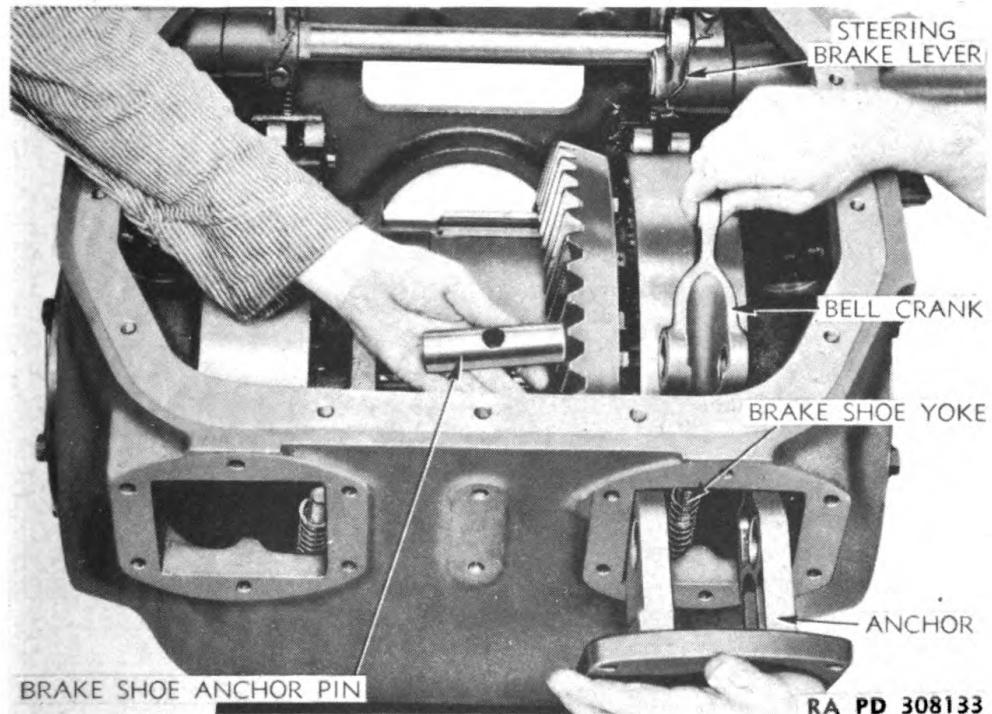


Figure 33 — Removing Steering Brake Anchor and Bell Crank

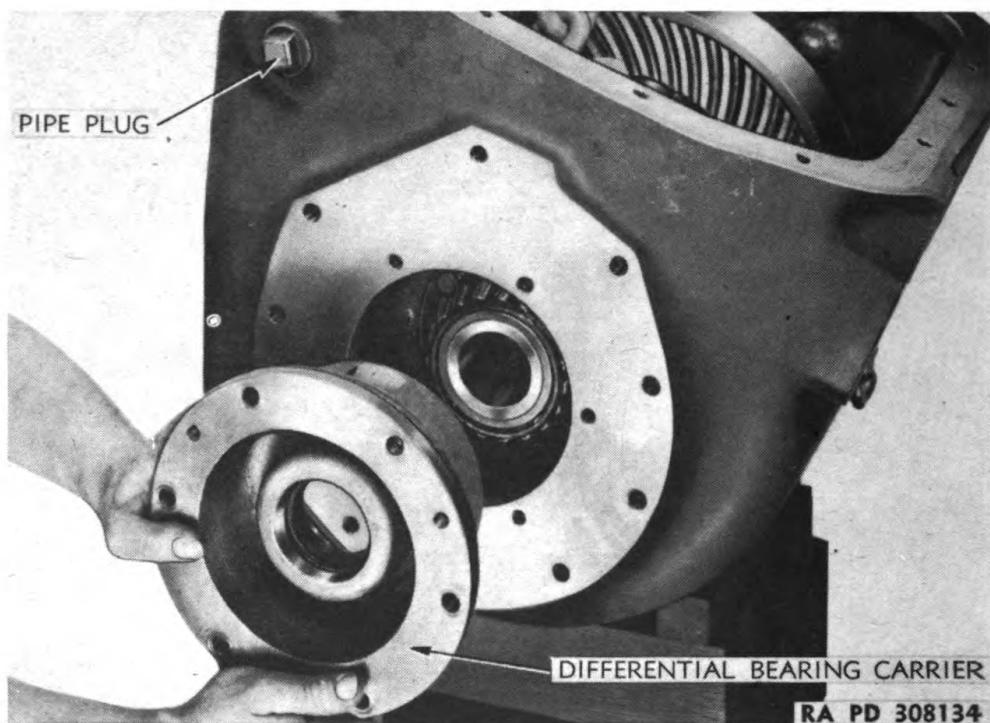
ORDNANCE MAINTENANCE – POWER TRAIN, SUSPENSION, AND EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4

Figure 34 – Differential Bearing Carrier Removed

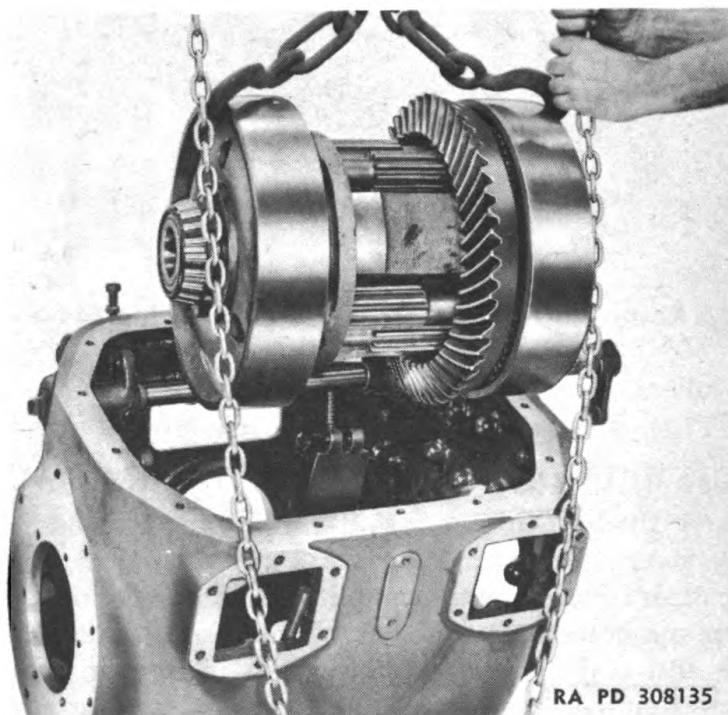
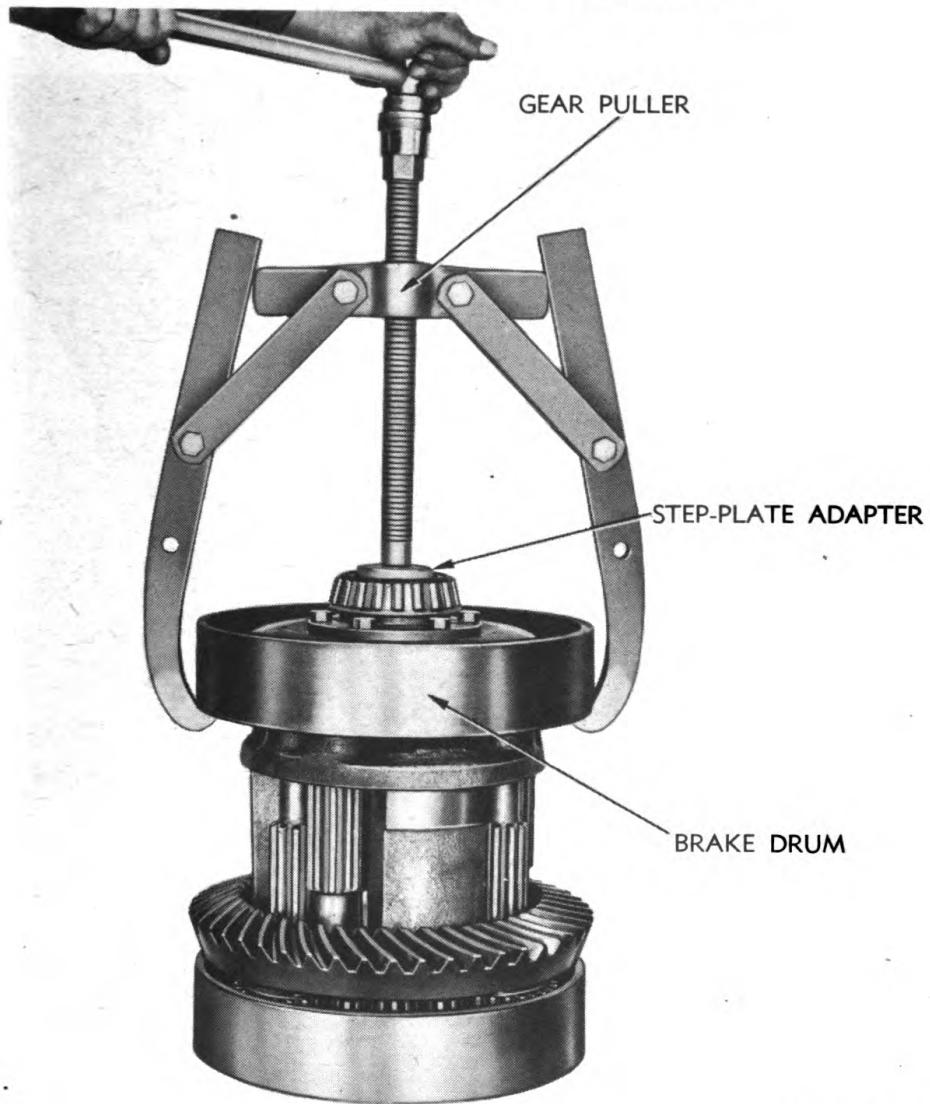


Figure 35 – Differential Assembly Removed

TRANSMISSION AND DIFFERENTIAL



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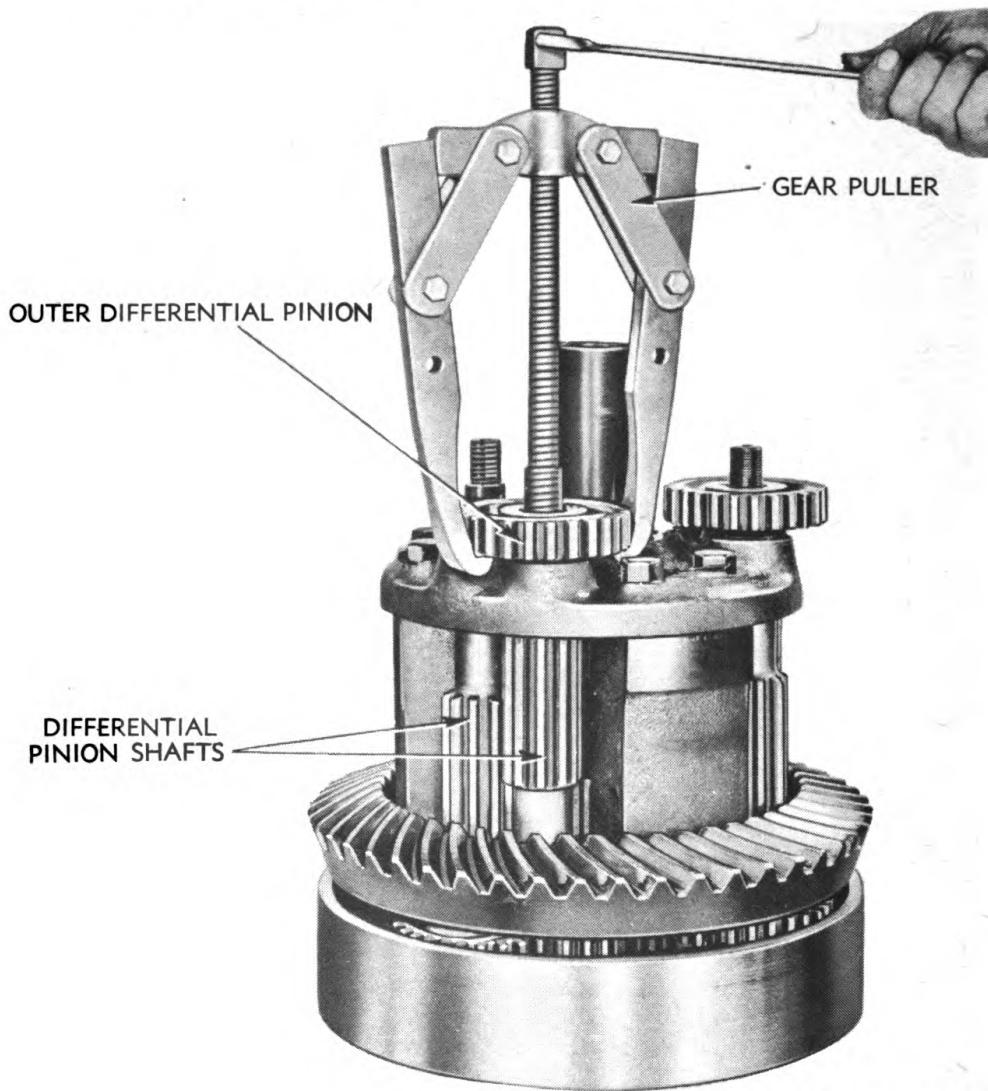
Figure 36 – Removing Brake Drum, Using Puller (41-P-2910-50)

race from rollers. Remove rollers from cage, then remove snap ring from groove in cam and lift cage off cam. Remove spring from cam.

15. DISASSEMBLY OF CONTROLLED DIFFERENTIAL.

a. Remove Brake Linkage. Pull cotter pins and end yoke pins and remove steering brake rods (fig. 32). Disconnect both ends of top brake shoes by removing coupling pins and remove both top shoes. Remove cotter pin and flat washer from outer end of each brake shoe and bell crank pin (lower pin in anchor) and remove these pins. Remove brake shoe adjusting nuts from brake shoe yokes. Remove the six attaching cap screws from each brake anchor, maneuver anchors to remove anchor pins from anchors and brake shoe

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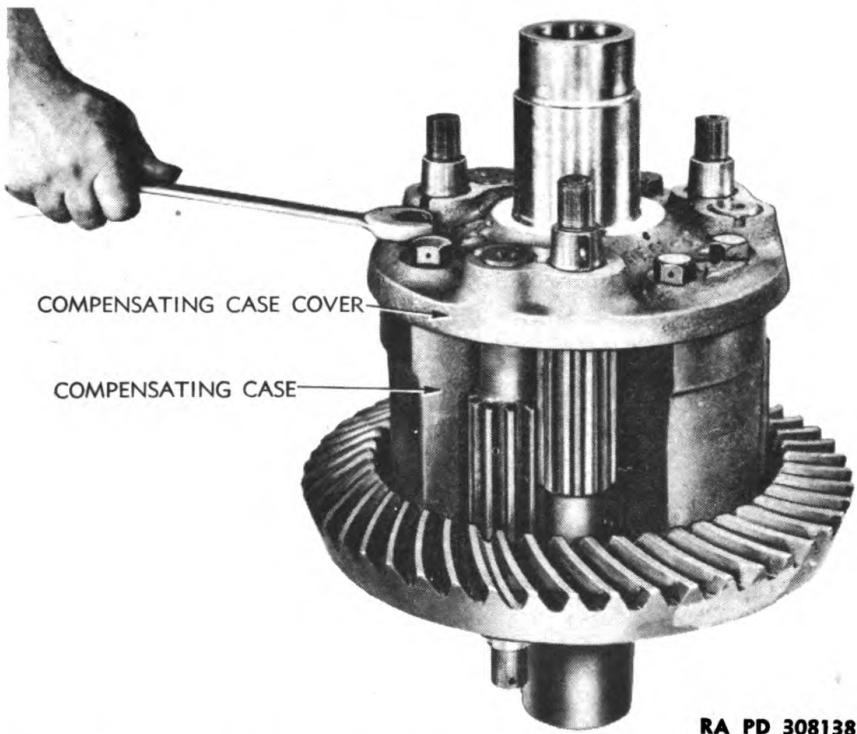
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**Figure 37 – Removing Differential Outer Pinion,
Using Puller (41-P-2911)**

yokes and remove anchor pins, bell cranks, and anchors (fig. 33). Slide return springs off yokes.

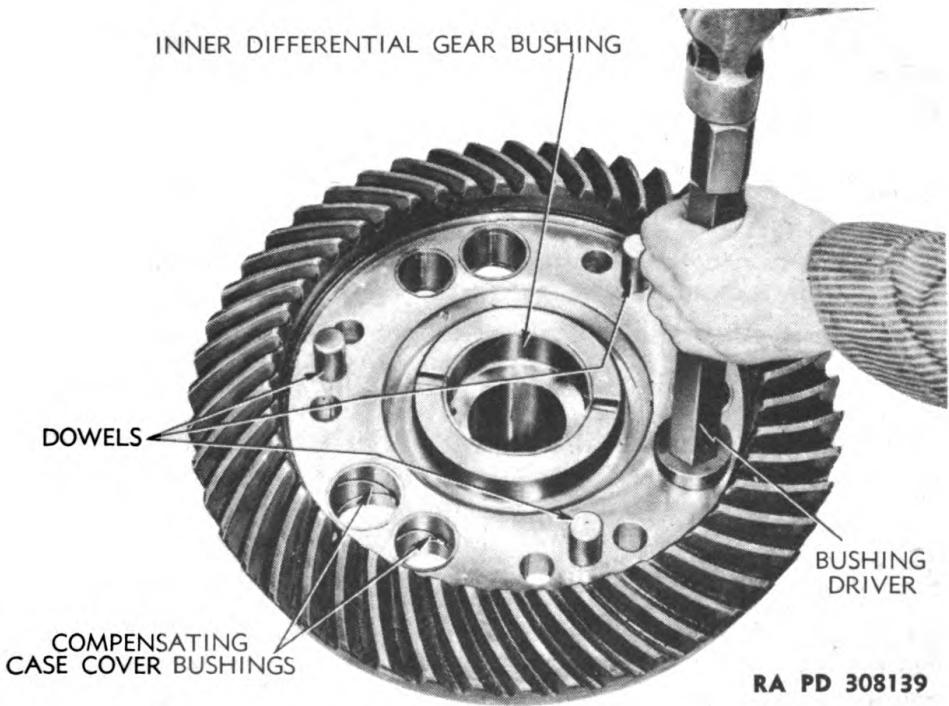
b. Remove Differential Assembly From Case. Swing hoist into position over differential, engage hooks of lifting chain under rim of brake drums as shown in figure 35 and take up slack in hoist chain to support weight of differential. Cut lock wire and remove the six retaining cap screws from each differential bearing carrier. Mark carriers and housing with center punch for relative position in housing. Force carriers out of case by installing three cap screws in tapped holes in carriers and remove bearing carriers and shims (fig. 34).

TRANSMISSION AND DIFFERENTIAL



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Figure 38 — Removing Compensating Case Cover



RA PD 308139

Figure 39 — Removing Compensating Case Cover Bushings

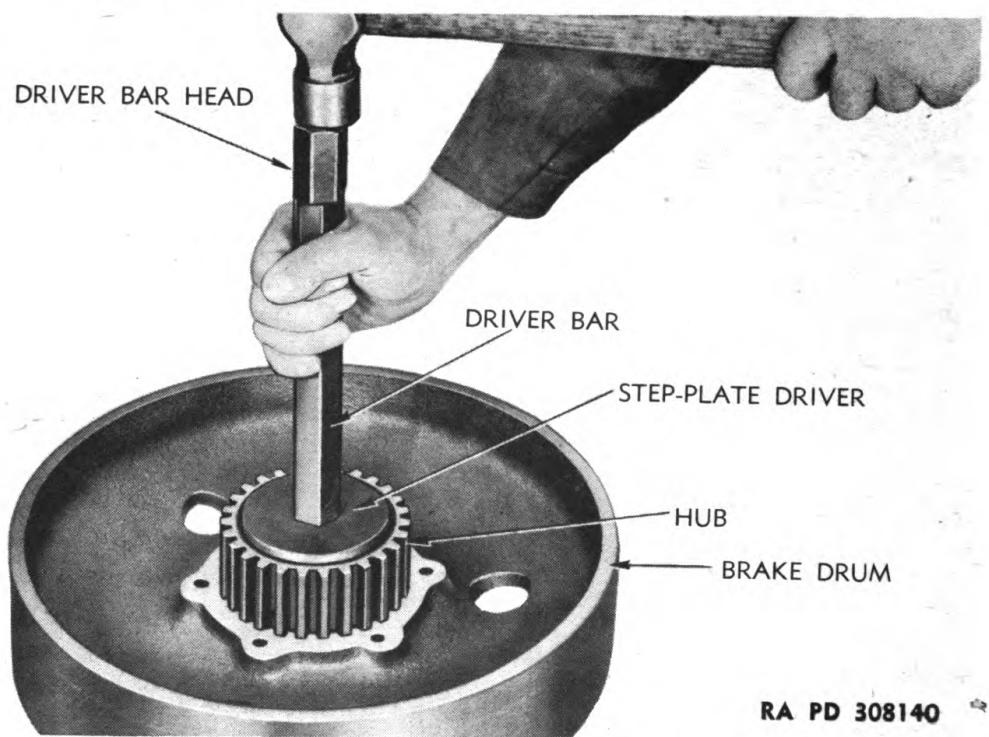
ORDNANCE MAINTENANCE – POWER TRAIN, SUSPENSION, AND EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4


Figure 40 – Removing Brake Drum Hub Bushing

Wire shims removed, to the carrier with which they were removed. Cut lock wire and remove clamp screw from steering brake lever on steering brake shaft for left brake (fig. 33). Make file or punch mark on shaft and lever to mark the relative position of lever on shaft, then tap lever off end of shaft. Pull shaft out until end of shaft is flush with inside of case. Lift differential assembly out of case (fig. 35), then remove brake shoes remaining in case.

c. **Disassemble Differential Assembly.** Set assembly on blocks as (fig. 36), to prevent its tipping. Using puller (41-P-2910-50) installed as shown in illustration, pull brake drum and hub assembly, bearing, and drum hub thrust washer from hub. Remove the same parts from other end in same manner. Pull cotter pins and remove slotted nuts from ends of the six differential pinion shafts. Using gear puller (fig. 37), pull outer pinions from shafts. Gears can be held from turning by placing a short piece of square key stock or similar material between teeth of pinions in such manner that teeth will not be damaged. Remove keys from slots in shaft after pulling pinions. Remove lock wires from heads of cap screws and remove the six cap screws that attach right compensating case cover to compensating case (fig. 38). Mark cover and compensating case with center punch so it can be reinstalled in same position, then tap cover off dowels in compensating case. Dowels may remain in covers. Lift pinion shafts

TRANSMISSION AND DIFFERENTIAL

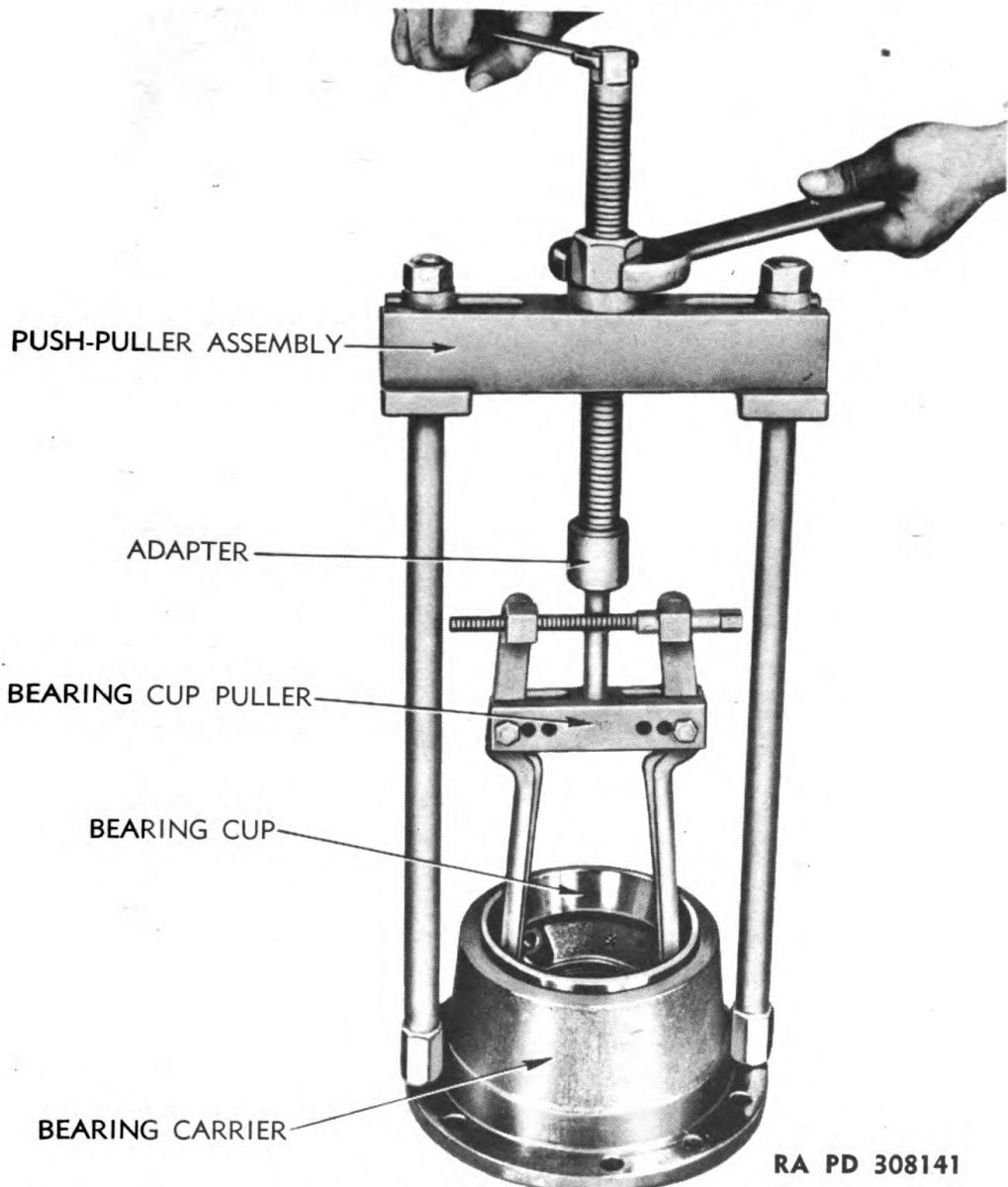


Figure 41 — Removing Bearing Cup From Bearing Carrier, Using Puller (41-P-2905-60)

from left cover and inner differential gear from case. Repeat above operations to remove left cover and bevel gear. Remove bevel gear from left cover by cutting lock wire and removing the 12 cap screws in cover and gear, then tapping or pressing cover from gear.

d. Remove Bushings From Compensating Case Covers (fig. 39). Using care not to injure covers, tap small chisel between inner differential gear bushings and covers to spring bushings together and remove bushings. Using bushing drivers or arbor press, drive or press bushings from covers. **NOTE: Do not remove these bushings**

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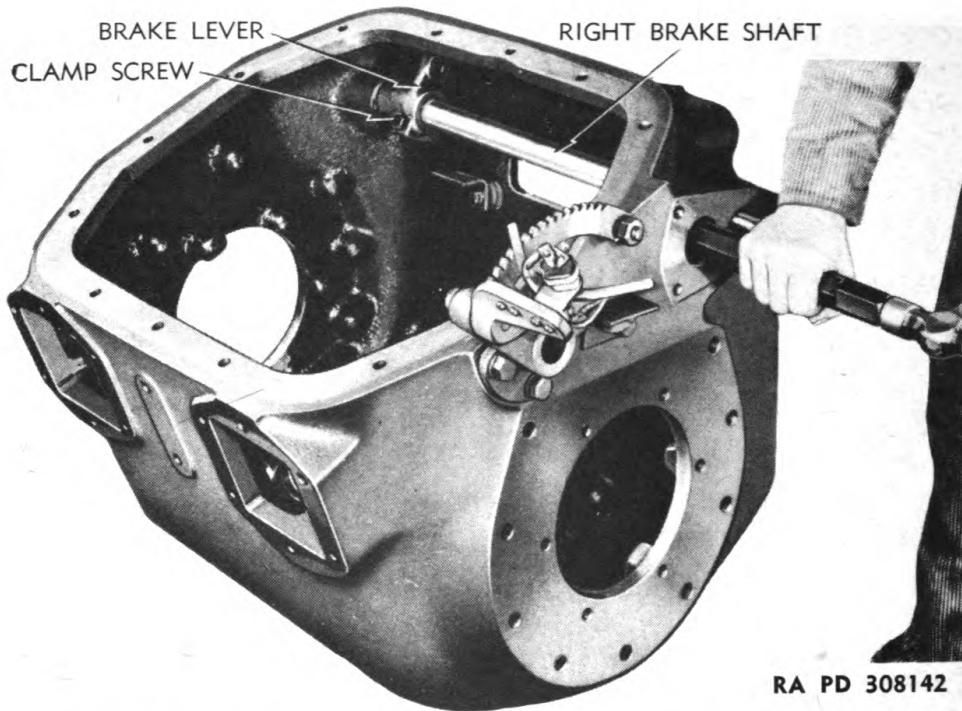


Figure 42 – Removing Brake Shaft Bushing, Using Remover (41-R-2376-290)

unless inspection proves they must be replaced with new ones. Replacement of these bushings requires a special reamer. Do not attempt to remove these bushings unless a special reamer is available.

e. Disassemble Brake Drum Assemblies (fig. 40). Place drum on blocks, and using remover (41-R-2376-295), handle (41-H-1396-665), and handle (41-H-1396-650), drive bushing from hub. **NOTE: Do not remove this bushing unless it is to be replaced with new one.** Cut lock wires, remove the six retaining cap screws from drum and hub, and tap hub out of drum. Repeat these operations on second brake drum.

f. Remove Bearing Cup and Oil Seals From Differential Bearing Carriers. Assemble bearing cup puller (41-P-2905-60) as shown in figure 41 and pull bearing cups from bearing carriers. Removal of the oil seals in bearing carriers will necessitate the installation of new seals as the old ones will be damaged.

g. Remove Brake Control Shafts From Housing (fig. 42). Cut and remove lock wires in clamp screws in collar and lever on long shaft. Remove clamp screws from collar and lever. Remove pipe plug from housing at end of long control shaft (fig. 34). Remove clamp screw, then tap lever off outer end of shaft (fig. 32). Remove

TRANSMISSION AND DIFFERENTIAL

three cap screws and remove steering brake shaft supporting bracket. Tap right brake shaft out of housing, removing lever and collar from shaft. Do not remove brake shaft bushings and oil seals unless new ones are to be installed as they will be damaged in removal. If they are to be removed, use remover (41-R-2376-290) to remove them.

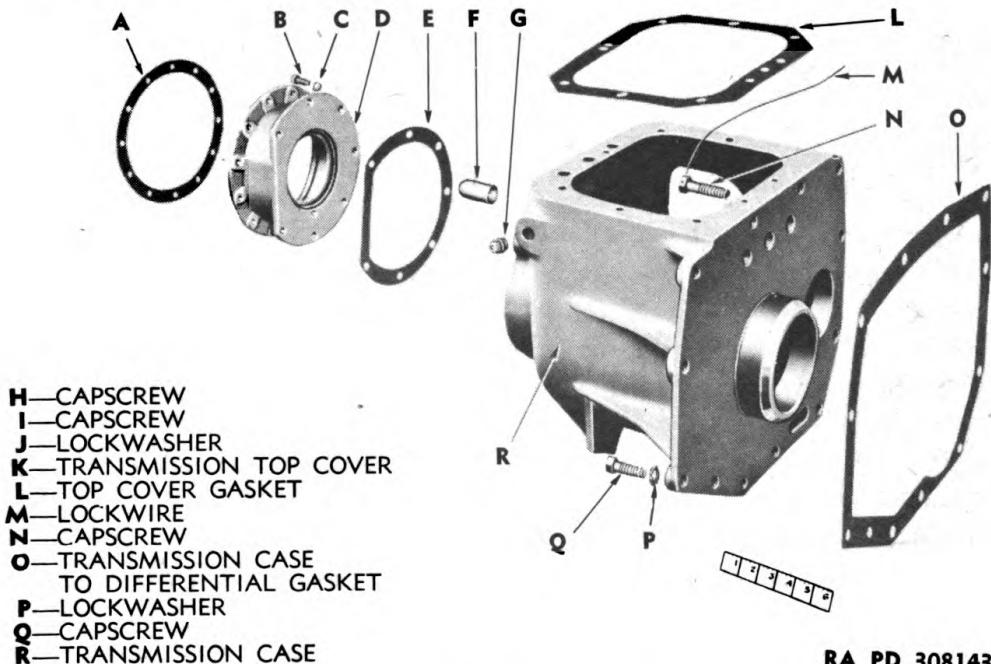
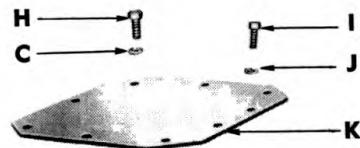
Section III

CLEANING, INSPECTION, AND REPAIR OF TRANSMISSION AND DIFFERENTIAL ASSEMBLIES

16. CLEANING OF PARTS.

a. Wash all parts of transmission and differential, including housing, with dry-cleaning solvent and blow off dry with compressed air. Sludge in the transmission oil often forms a hard deposit in the bearings and splines of shafts and may require a thorough soaking and

- A—TORQUE CONVERTER-TO-ADAPTER GASKET
- B—CAPSCREW
- C—LOCKWASHERS
- D—TORQUE CONVERTER-TO-TRANSMISSION ADAPTER
- E—TORQUE CONVERTER ADAPTER-TO-TRANSMISSION GASKET
- F—SHIFTER SHAFT COVER
- G—PIPE PLUG



RA PD 308143

Figure 43 — Transmission Case Covers Disassembled

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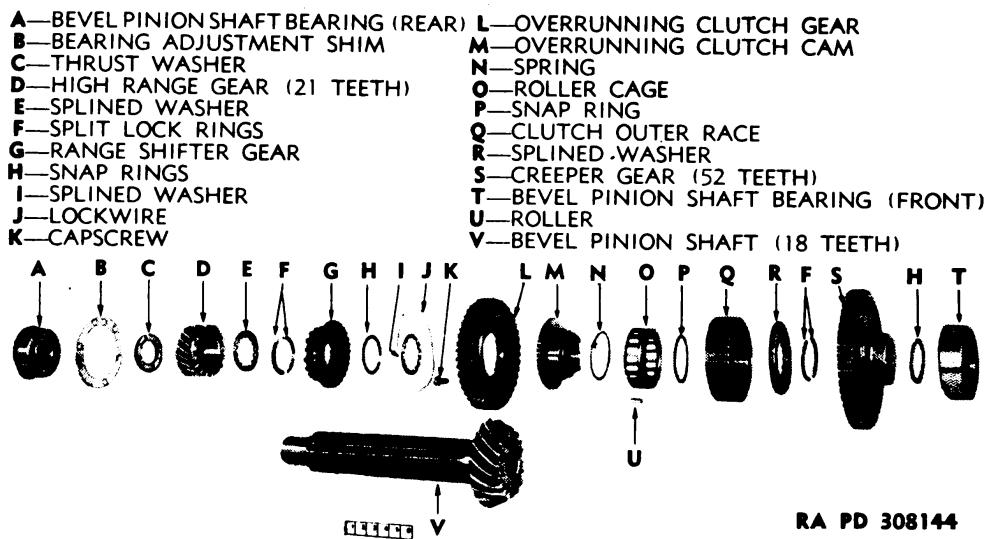


Figure 44 – Bevel Pinion Shaft and Gears Disassembled

washing in solvent before this can be removed. Rotate bearings in the dry-cleaning solution until they are thoroughly clean and all dirt or foreign matter is removed from them so they may be inspected and their condition be determined. Use compressed air to blow dirt and cleaning fluid from the bearings after they are washed. **CAUTION:** *Do not spin the bearings with compressed air after the lubricant has been washed from them.* After they are clean coat them with light engine oil and wrap them in paper to prevent rust or corrosion from taking place and to prevent dirt from collecting on them before they are again installed. Rotate the bearings of all other parts after they have been cleaned and inspected.

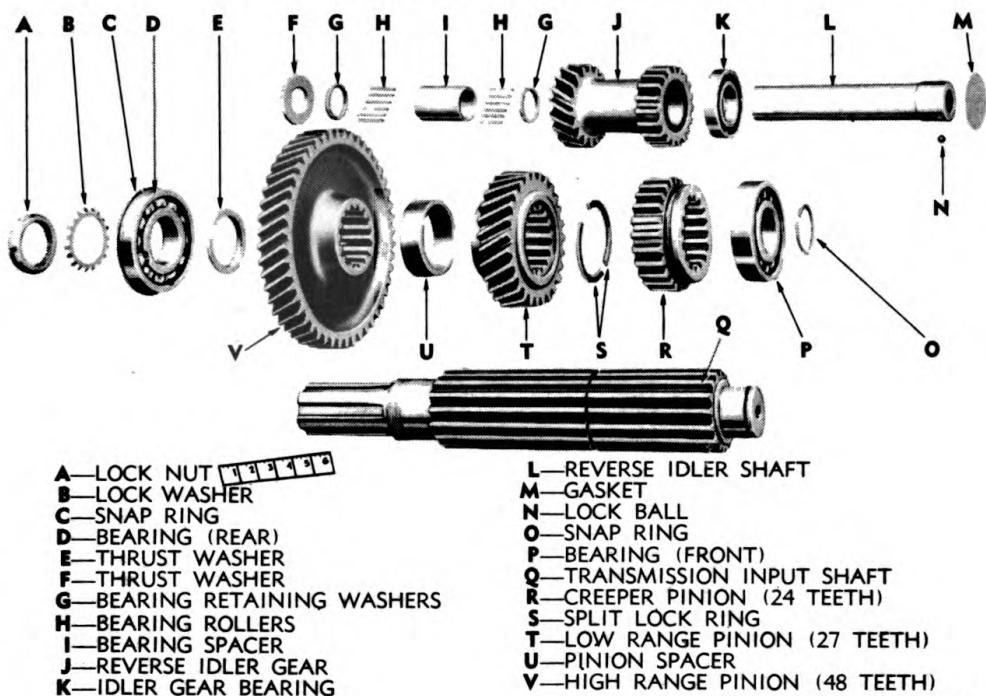
17. INSPECTION OF PARTS.

a. Transmission.

(1) **GEARS.** File or grind off burs on gears that are to be used again. Inspect all gears for general wear. Replace any gears that have chipped or broken teeth or that have teeth worn to a sharp edge that are apt to break off after a short period of operation. The replacement of one gear will require the replacement of any related or meshing gears or pinions. Make sure the inner splines of all gears are in good condition.

(2) **BEARINGS.** Since the operation of the transmission as a whole may depend on the condition of all or any one of the bearings which supports the different shafts and carry the total power load, it is very important that these be carefully inspected. The balls or rollers and races of bearings must be perfectly smooth and have brightly polished

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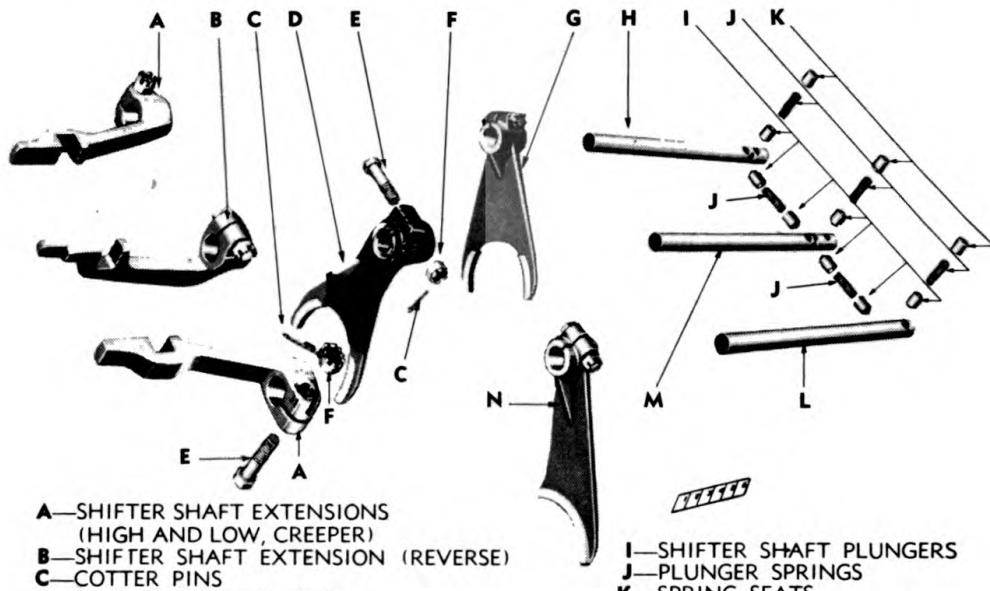
Figure 45 – Input and Reverse Idler Shaft Assemblies Disassembled

surfaces. Replace any bearings that have corroded, rough, chipped, or discolored surfaces or that show any tendency to bind when spun or rolled by hand. Discoloration of bearings is evidence of the bearing having been overheated in operation. Replace all worn bearings and bushings. Inspect inner bore of bearing cones; replace any that show signs of having turned on shaft.

(3) TRANSMISSION SHAFTS (figs. 44 and 45). Check shafts for straightness and general condition. Try bearings on their respective shafts. All bearings must fit on shafts with a light press fit. Make sure the bearing surfaces on shafts are smooth and that there are no burs preventing bearing from fitting tightly against shoulders on shafts. Try all gears on their respective shafts to make sure they slide easily in the shaft splines. If splines are badly worn or damaged by the gears, replace gears or shafts. Make sure all snap rings and snap ring grooves are not worn or rounded to the point where snap rings may be broken or slip out of grooves. Make sure all threads in transmission case or transmission shafts are clean and in good condition.

(4) TRANSMISSION SHIFTER SHAFTS AND SHIFTER FORKS (fig. 46). Make sure shifter shafts are straight and slide easily in the bushings in case. Straighten or replace bent shafts or forks. Inspect both for wear. The original thickness of the part of forks that engage collars

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A—SHIFTER SHAFT EXTENSIONS
 (HIGH AND LOW, CREEPER)
B—SHIFTER SHAFT EXTENSION (REVERSE)
C—COTTER PINS
D—REVERSE SHIFTER FORK
E—CLAMP BOLTS
F—NUTS
G—HIGH AND LOW SHIFTER FORK
H—HIGH AND LOW SHIFTER SHAFT

I—SHIFTER SHAFT PLUNGERS
J—PLUNGER SPRINGS
K—SPRING SEATS
L—CREEPER SHIFTER SHAFT
M—REVERSE SHIFTER SHAFT
N—CREEPER SHIFTER FORK

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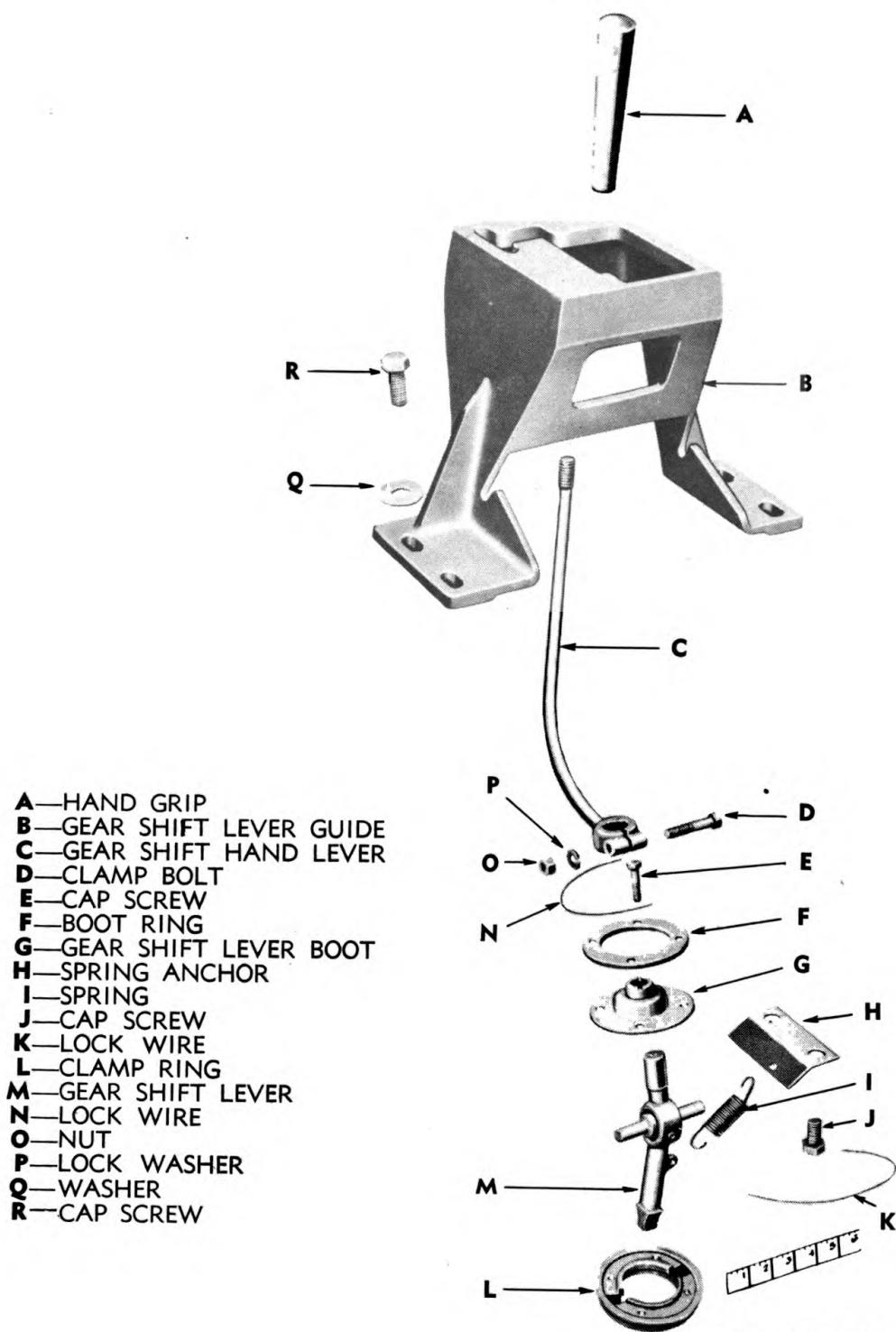
Figure 46 – Shifter Shafts and Forks Disassembled

in sliding gears is 0.360 to 0.370 inch. Bent forks or excessive roughness of forks in shifter collars of gears will result in interference of gears or incomplete engagement of gears when shifted. If necessary the bolts may be built up to eliminate looseness in collars by welding or brazing and then grinding to make a free fit in the gear collars.

(5) REVERSE IDLER GEAR ASSEMBLY. Either bronze bushings or needle roller bearings will be found in the reverse idler gear. Tractors with serial numbers M4-251 and lower are equipped with bronze bushings, those with serial numbers higher than M4-251 are equipped with needle roller bearings. If bronze bushings are worn to allow more than 0.010-inch clearance between bushing and shaft, replace bushing or shaft, whichever is worn. If equipped with needle roller bearings, inspect all needles carefully. To check wear on needle bearings, micrometers will be necessary. Twice the diameter of one of the needles added to the outside diameter of the collar must be 0.003 inch to 0.004 inch less than the diameter of the bore of the gear. If worn more than 0.005 inch, replace the bearing or gear.

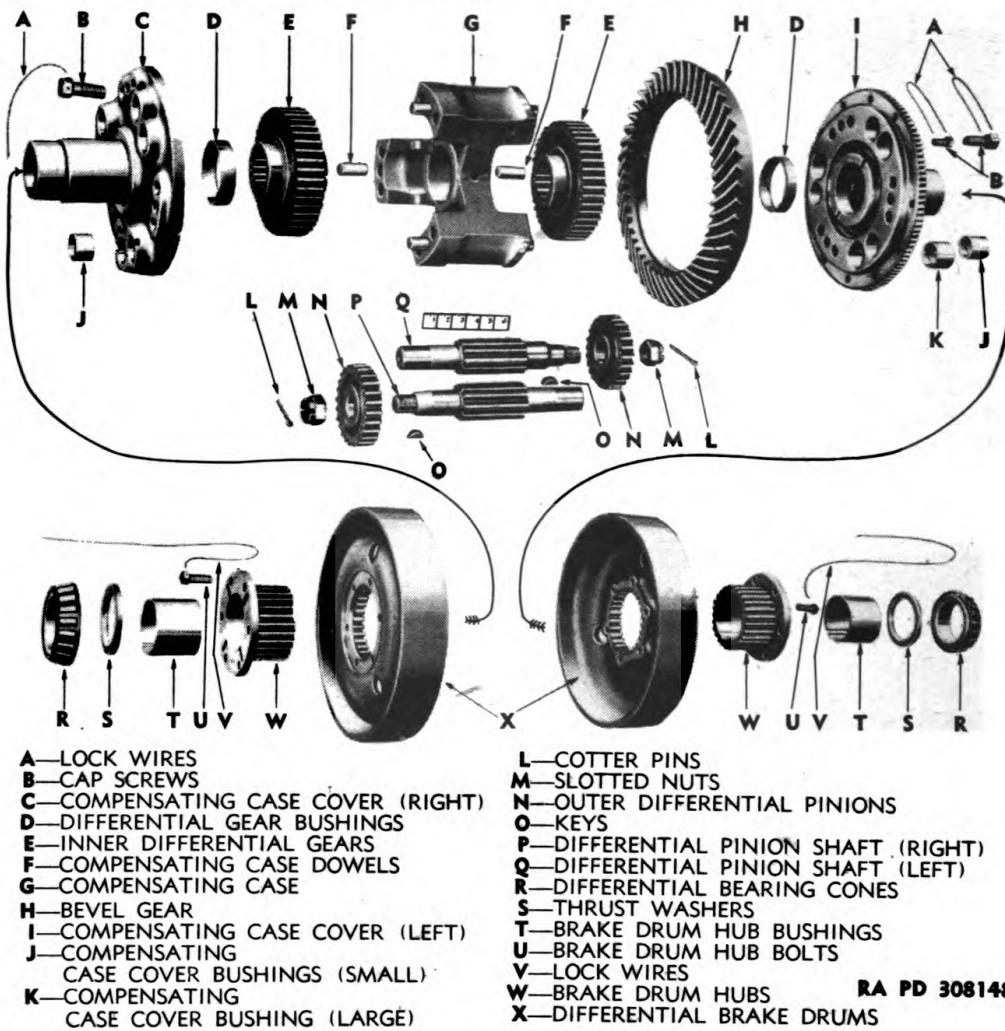
(6) THRUST WASHERS AND SHIFTER SHAFT LOCKS. The new dimensions of all thrust washers are specified in section VIII. Replace washers if scored or worn. Inspect shifter shaft lock plungers and springs to make sure shifter shafts will lock properly.

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Figure 47 — Gear Shift Lever Assembly Disassembled

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Figure 48 – Differential Assembly Disassembled
b. Differential Assembly.

(1) **GENERAL.** Since this controlled differential assembly is similar to those used in the light tank, the inspection procedure set up for these other vehicles can be followed for this differential assembly. Refer to subparagraph a (1) and (2), above, for inspection of gears and bearings.

(2) **DIFFERENTIAL PINIONS AND BUSHINGS** (fig. 48). Inspect these pinions carefully to detect signs of wear or damage. When new, the pinion shafts have a clearance of from 0.008 to 0.009 inch in the bushings. Replace the pinions if the teeth are scuffed due to worn bushings or if teeth are damaged in any way. These must be replaced in pairs. Make sure the threads on ends of shafts and the nuts that go on these shafts are in good condition.

(3) **BRAKE DRUMS AND BRAKE BANDS** (fig. 48). Brake drums

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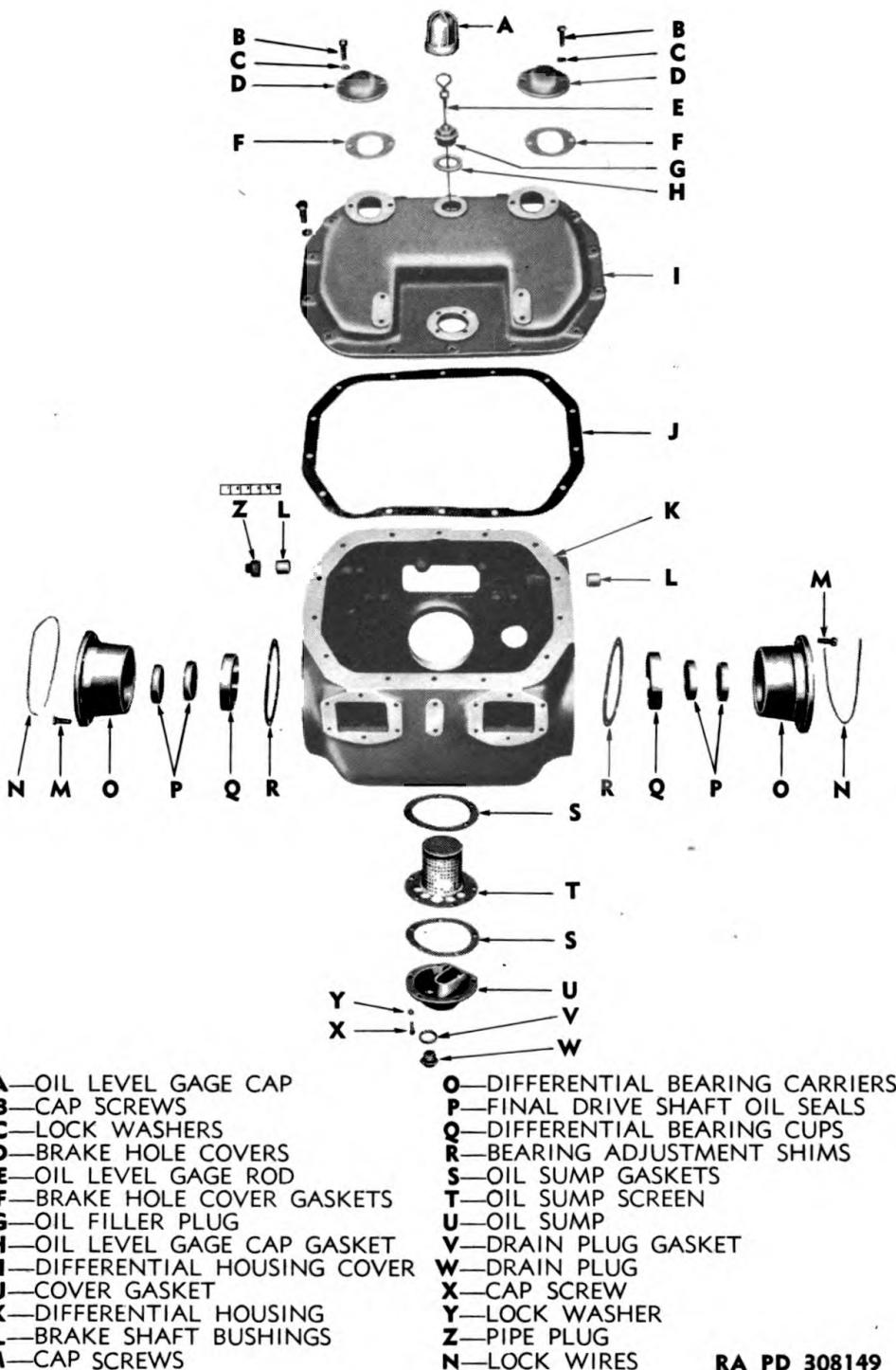


Figure 49 — Differential Case and Covers Disassembled

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that are scored due to contact with the brake lining rivets may be smoothed in a lathe but if the thickness of the material remaining is less than one-fourth inch replace the drums. Inspect the brake bands and linings. If lining is worn down nearly to rivet head, or would be worn to that extent after another short period of operation, it must be replaced. Replace brake shoes or coupling pins if worn to allow more than 0.010-inch clearance. Make sure all control rods are straight and all adjustment linkage is in good condition.

(4) DIFFERENTIAL CASE (fig. 49). File off any burs on machined surfaces that would prevent correct contact of mating parts. Inspect case for cracks or breaks and inspect drain plug magnet to make sure it will attract small metal particles.

Section IV

ASSEMBLY OF TRANSMISSION AND DIFFERENTIAL

18. GENERAL.

a. As cleanliness is of extreme importance, provide a clean working space, clean benches, and a good supply of clean wiping cloths for assembly of these units. Procure the necessary special tools required for the various assembly operations. Special tools are listed and shown in chapter 10. Make sure all parts that are installed are in good usable condition and fit properly in relation to other parts. All gears and shafts must roll freely after assembled. Lubricate all bushings, bearings, and shaft splines with light engine oil during assembly.

19. ASSEMBLY OF CONTROLLED DIFFERENTIAL.

a. Assemble Subassemblies.

(1) ASSEMBLE BRAKE DRUMS AND HUBS. If bushings were removed from hubs, use remover and replacer with handles the same as that used to remove old bushing (par. 15 e) or arbor press to install new one. Align oilholes in bushing and hubs and lock bushings in place by staking ends of bushings into notches in hubs in a manner similar to that shown in figure 51. These bushings must have 0.005- to 0.008-inch clearance with gear hub. To install hubs in brake drums, place drum on bench with offset of drum up, align bolt holes of hub with those in drum, and drop hub through drum. Install and tighten six drilled head cap screws and secure cap screws from loosening with lock wire through cap screw heads.

(2) ASSEMBLE DIFFERENTIAL BEARING CARRIER ASSEMBLIES. Tap or press two oil seals into each bearing carrier with lips of seals

TRANSMISSION AND DIFFERENTIAL

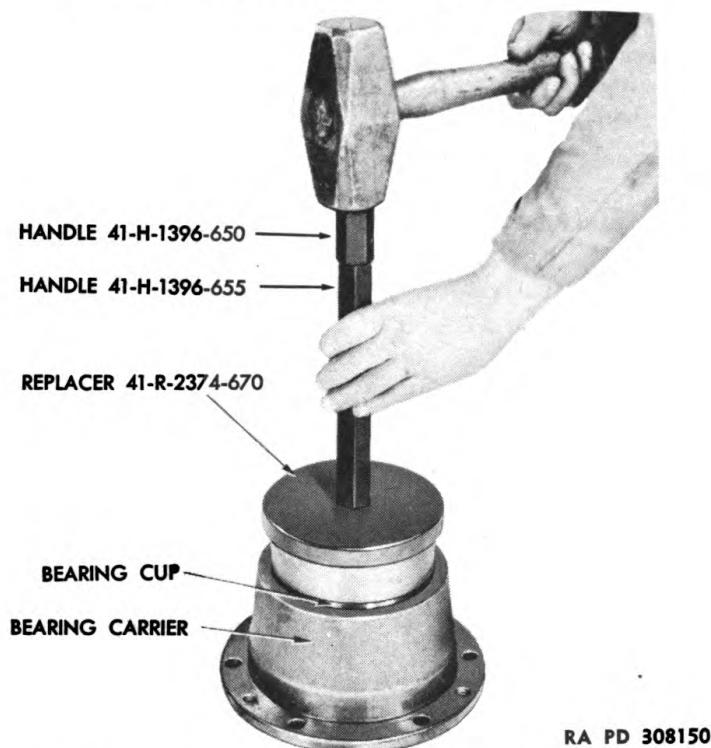


Figure 50 – Installing Differential Bearing Cup

facing away from each other, then drive or press bearing cup into carrier with largest inside diameter of cup up. Figure 50 shows cup being installed with remover and replacer (41-R-2374-670), handle (41-H-1396-655) and handle (41-H-1396-650).

(3) **INSTALL BUSHINGS IN COMPENSATING CASE COVERS.** If bushings were removed from covers, install new ones using a piece of stock as shown in figure 51 or arbor press. Align oilholes in bushings with holes in cover when installing. Stake bushings in place after installation. These bushings must have 0.005- to 0.008-inch running clearance.

The installation of new bushings in compensating case covers for the differential pinion shafts requires the use of a special reamer to insure proper alignment of the differential pinion shafts. Do not attempt to install new bushings unless this tool is available. Using an arbor press or a piece of bar stock machined to proper size, drive or press the new bushings into covers. These bushings also have oil-holes that must be aligned with holes in cover when installed. After bushings have been installed, attach the two covers to compensating case with six cap screws in each. The marks made on the case and covers in disassembly must be used to make sure the covers are installed on the same side of case and in the same position as before the unit was disassembled. Place compensating case and cover

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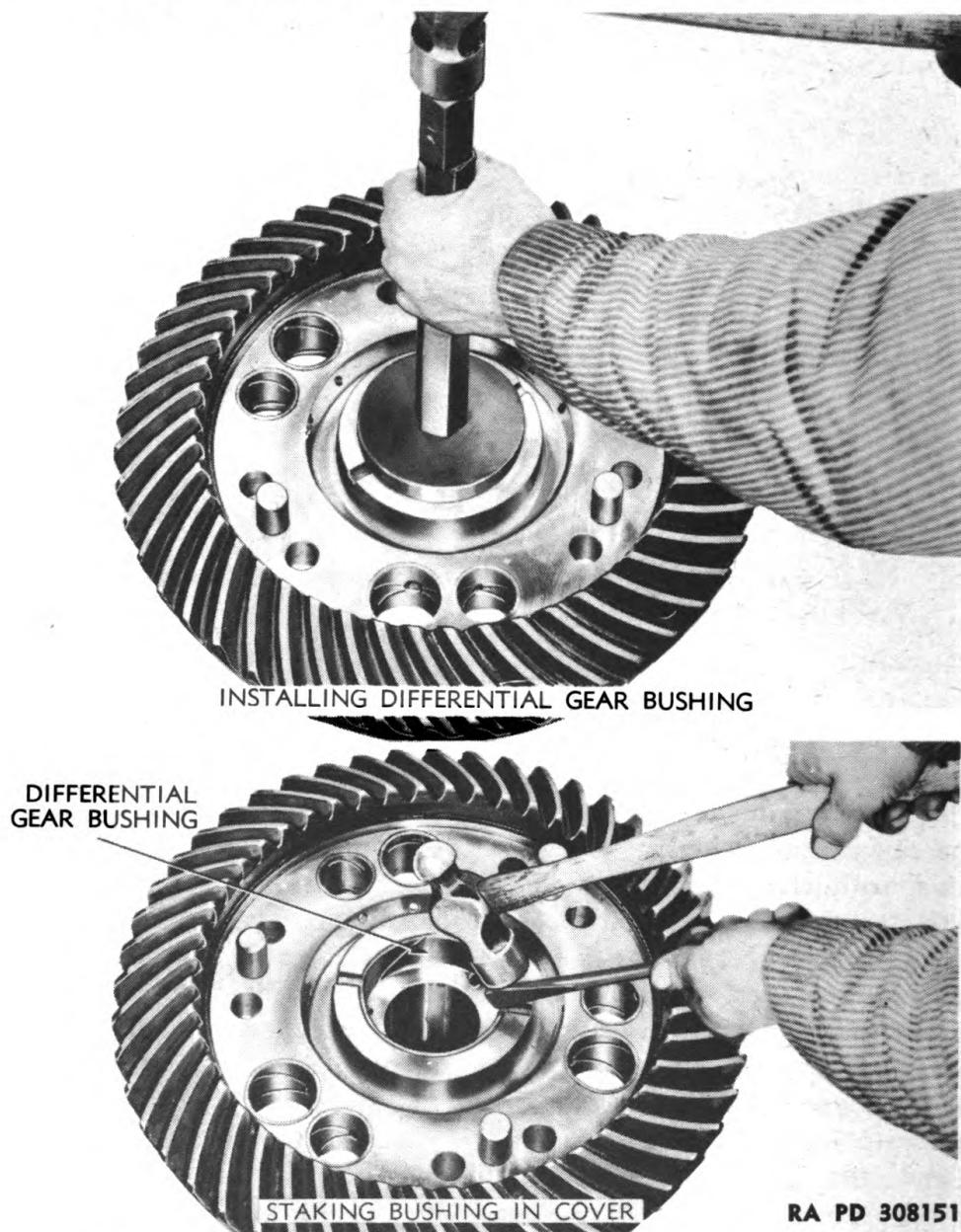
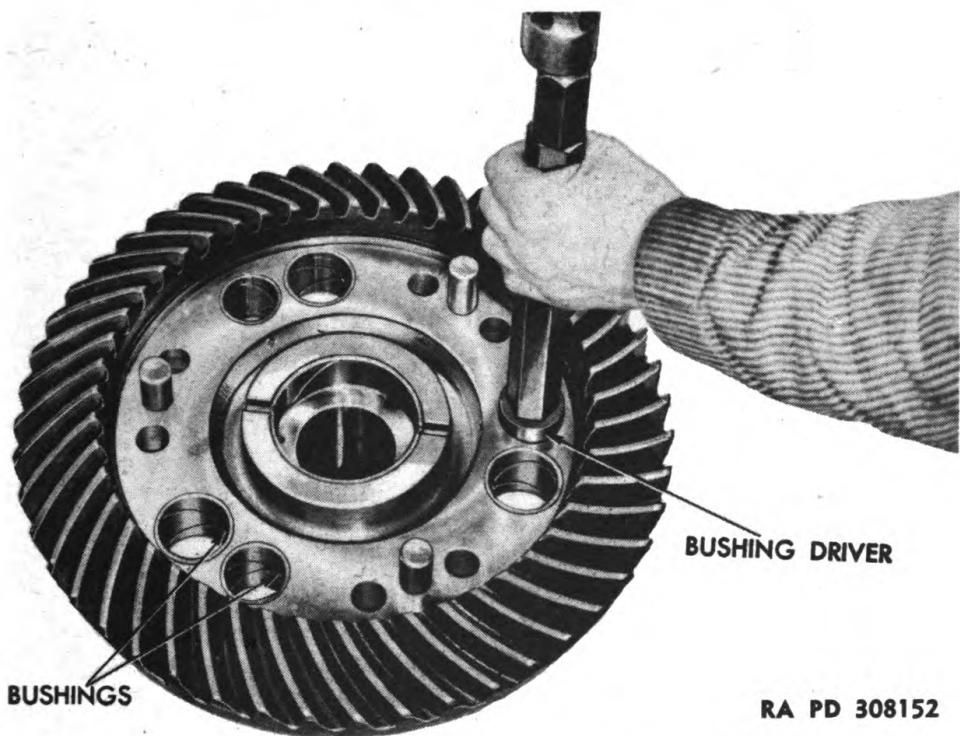


Figure 51 – Installing Differential Gear Bushings

assembly in vise. Using special reamers, ream bushings which have been installed. Remove covers from case and clean out all metal particles.

(4) ASSEMBLE DIFFERENTIAL GEAR ASSEMBLY. Lay bevel gear on bench, line up bolt holes in bevel gear with those in left compensating case cover and lower cover into gear. Attach to gear with 12 drilled head cap screws. After cap screws are tightened securely, install lock wire in each pair of cap screws, crossing wires (fig. 53).

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Figure 52 — Installing Bushings in Compensating Case Cover

Place gear and cover on blocks with gear up (fig. 54). Place one of the differential gears in cover. Then install compensating case on cover so dowels in cover or case enter center holes in cover or case. The dowels are unevenly spaced so the compensating case can go on only in the correct position, however, marks made on the case and covers when unit was disassembled will be used to determine which end of the case goes toward this cover. Tap case down onto dowels in cover. Place second differential gear in compensating case. Try all gears as they are installed for free fit in bushings. Next select the three differential shafts that have journals of the same diameter at both ends. Set these three shafts (threaded end up) in the three smaller bushings in end cover and turn these shafts so the keyways in upper ends of shafts all face towards the center (fig. 55). The template shown is used only for illustration of proper setting of keyways. Insert the threaded ends of the three pinion shafts which have journals of two different diameters, in the other three bushings in cover, meshing the gears with the other three gears already installed so that the keyways in these shafts also point towards center. Then install the right cover on dowels in upper end of compensating case in same manner as the lower cover. Attach covers to compensating case with six drilled head cap screws, securely tightened and secured with lock wire (fig. 56). Drive dowels through covers and into ends of com-

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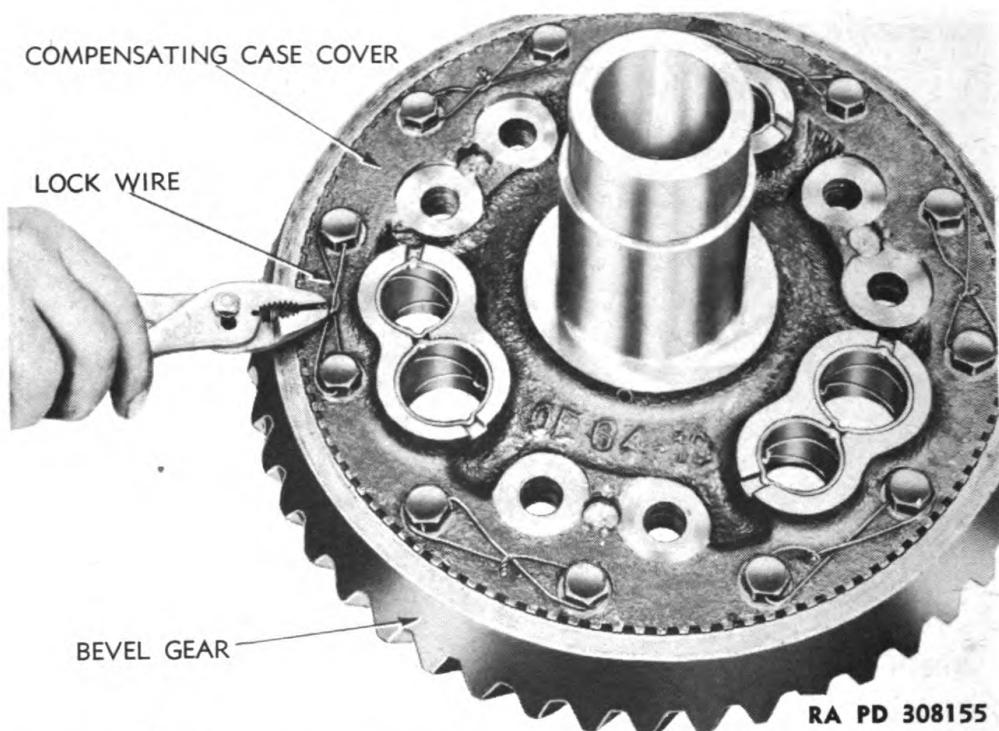


Figure 53 – Installing Bevel Gear on Compensating Case Cover

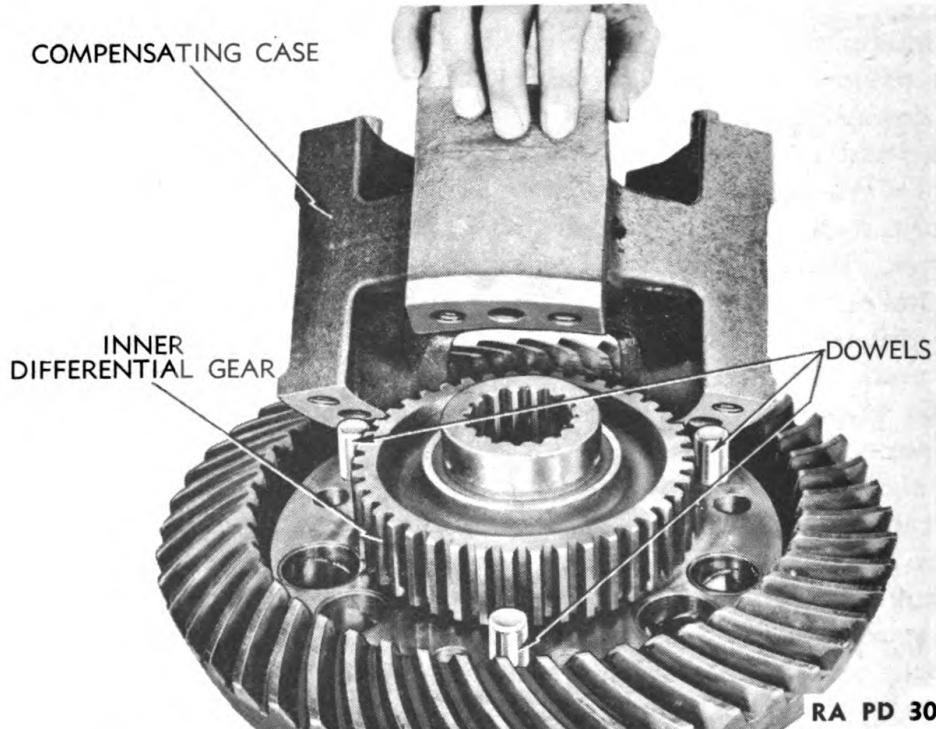
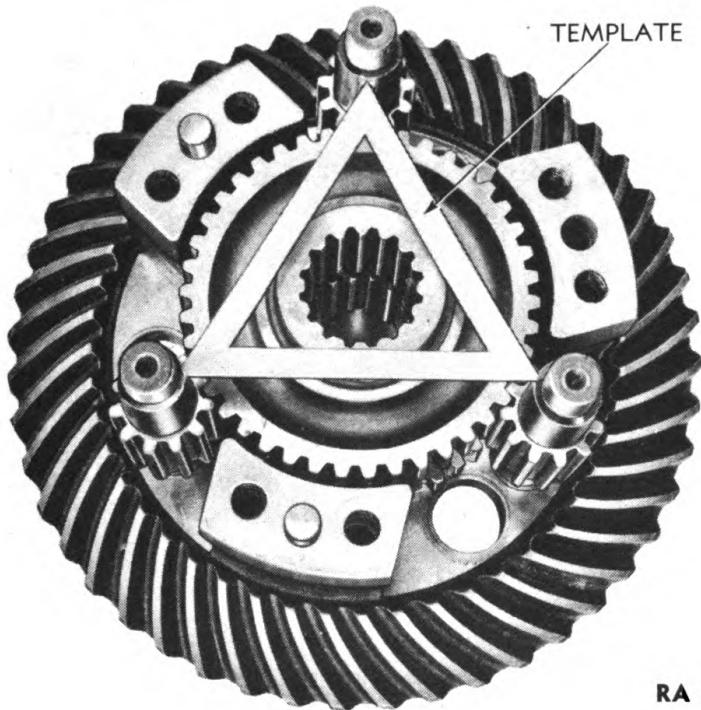


Figure 54 – Installing Differential Gear and Compensating Case

TRANSMISSION AND DIFFERENTIAL



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Figure 55 — Position of Differential Pinion Shafts

pensating case far enough to peen edges of holes in covers over ends of dowels. Tap keps into the keyways of pinion shafts, then install the six outer differential pinions on the ends of shafts (fig. 37). The threaded ends of the shafts are numbered from 1 to 6 as are the gears. Place the gears on the shafts so the numbers correspond. Install slotted nuts on the shafts and tighten securely, then install cotter pins through nuts and shafts. Place brake drum assemblies on hubs of compensating case covers, installing and testing each one separately to make sure the outer differential pinions mesh freely with gear teeth of brake drum hub. If pinion shafts are correctly positioned by means of the keyways, these gears will mesh and turn freely. If binding is evident, check for incorrect assembly. Disassemble and reassemble if necessary. If tests prove satisfactory, slip a brake drum hub thrust washer on each hub against brake drum, then tap or press differential bearing cone and roller assemblies onto ends of hub and against thrust washers (fig. 56). Rotate gears to test for free rolling of gears.

b. Install Brake Control Shafts in Differential Housing (fig. 57). If old bushings were removed, install new bushings in outer ends of holes in brake shaft supporting bracket, using remover and replacer (41-R-2376-290) or arbor press. Leave bushings flush with outer side of bracket. Bushings must also be installed in inner ends of holes

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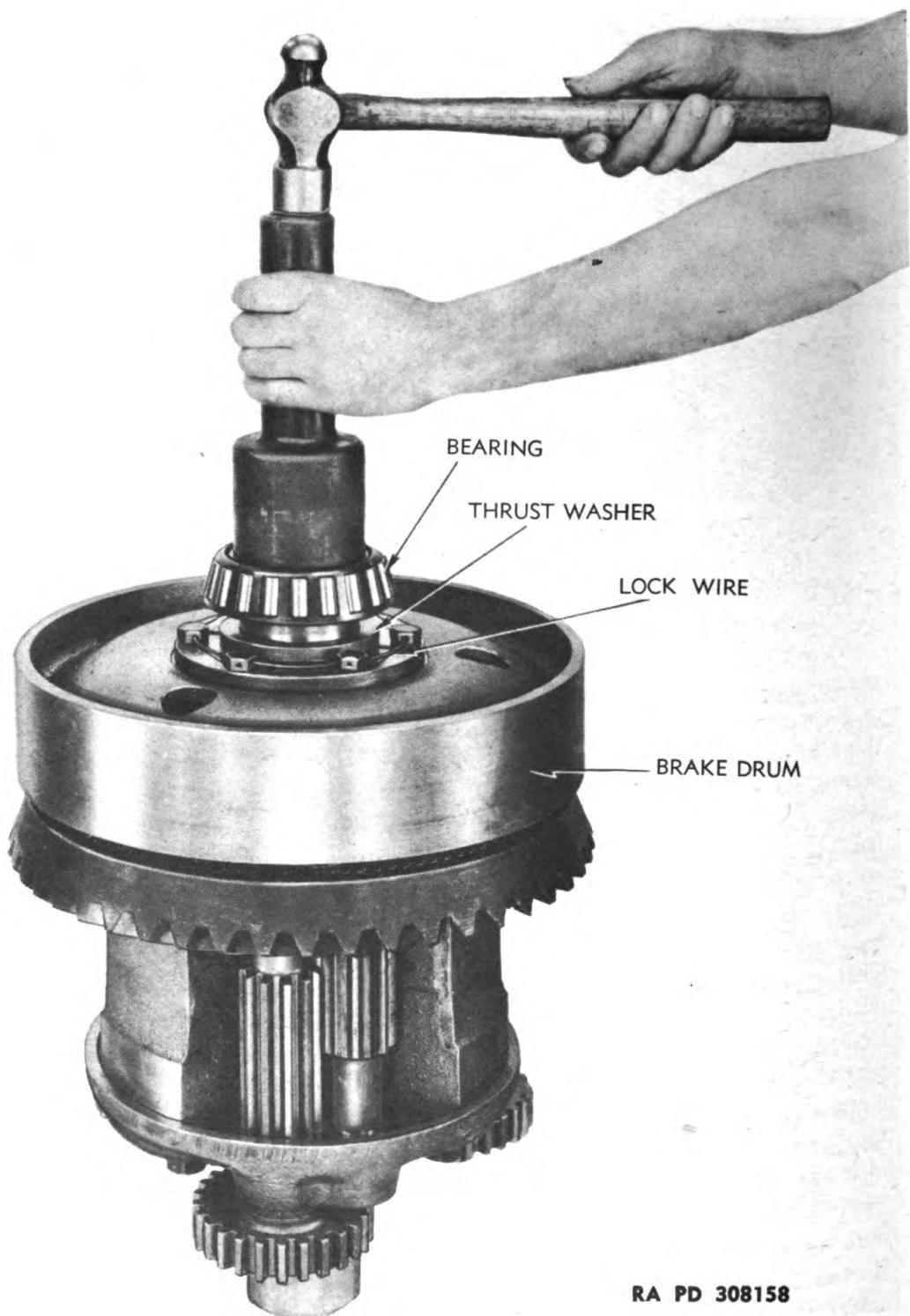


Figure 56—Installing Differential Bearing

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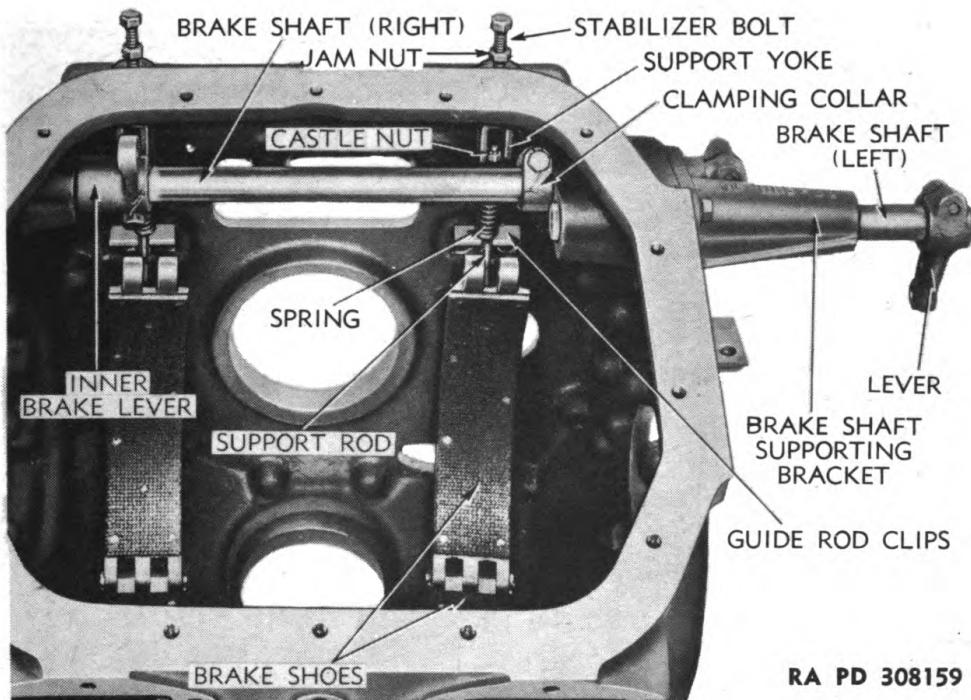


Figure 57 — Steering Brake Components

in housing that support inner ends of brake shafts. Use a piece of stock to install bushing for inner end of longer shaft. Leave bushings flush with inner side of housing. Ream bushings, if necessary for slip fit of shafts. Blow out all cuttings, then tap new oil seals, with lips of seals facing in, into counterbores in housing that will be covered by supporting bracket. Install bracket with three cap screws with lock washers. Install short brake lever on splined end of right brake shaft (longer of the two shafts) far enough to install clamp bolt. Install and tighten clamp bolt. Insert other end of shaft through shortest hole in supporting bracket, using care not to turn shaft and damage oil seal as shaft is pushed through. Slip clamping collar (machined side first) onto shaft, then tap inner lever on inner end of shaft, positioning lever on splines so it points opposite to the lever on outer end of shaft. Line up hole in lever with groove in shaft and install and tighten clamp bolt, then slip inner end of shaft into bushing in side of case. Position shaft clamping collar to hold shaft in proper position which will allow it to rotate freely and tighten clamp screw in collar. Secure clamp screws from loosening with lock wire. Install outer lever on left (short) brake shaft in same manner, then insert shaft through long hole in supporting bracket. Leave inner end of shaft flush with inner side of case and do not install inner lever until differential assembly has been installed in housing.

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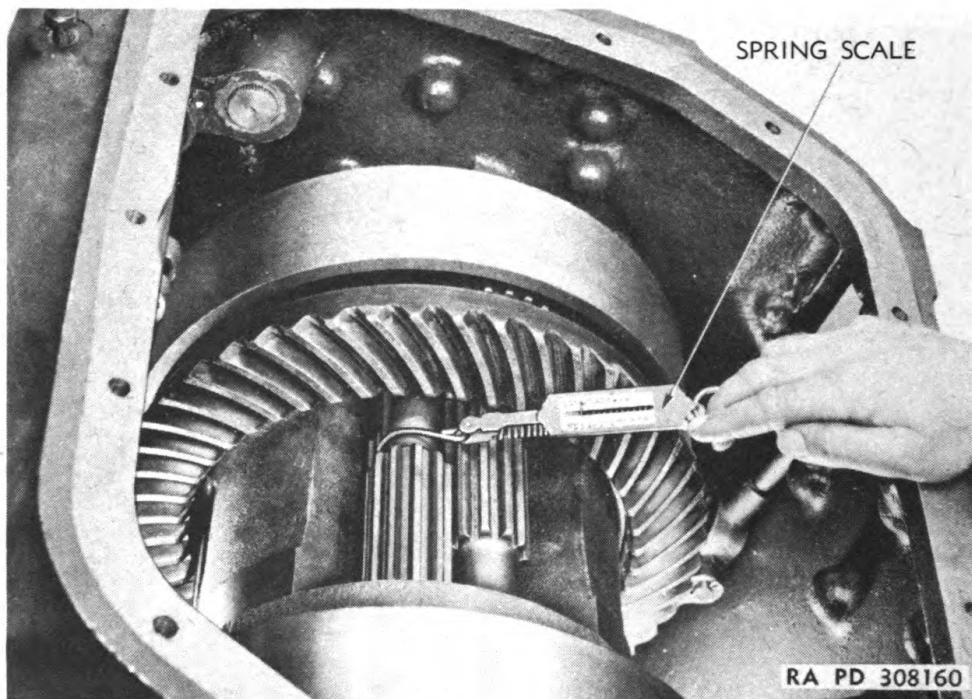


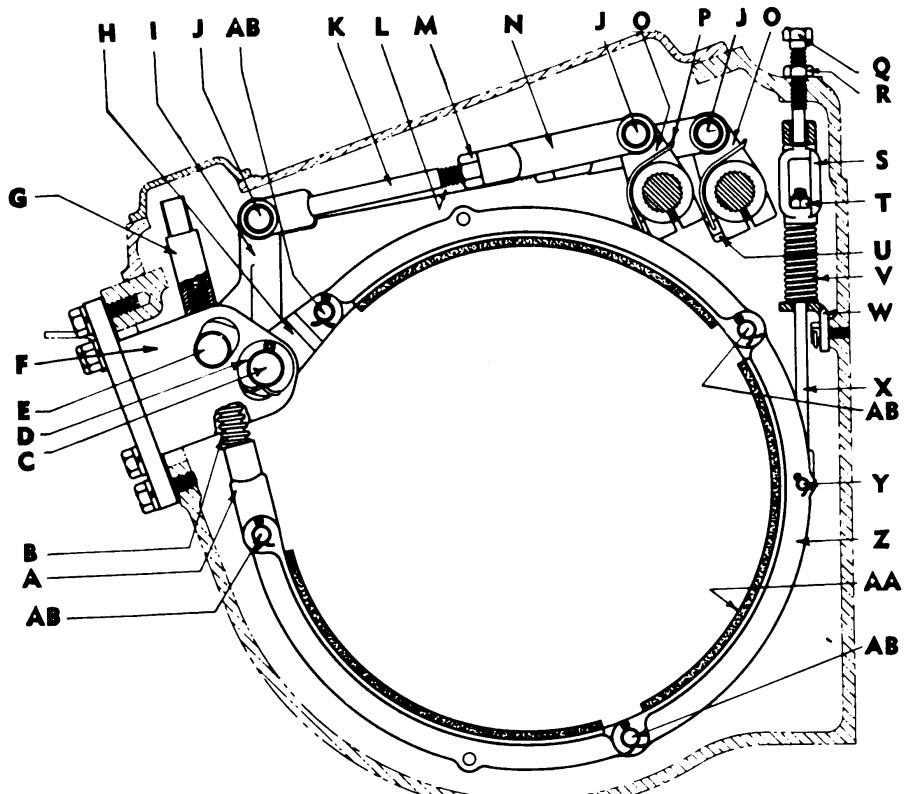
Figure 58 – Testing Differential Bearing Adjustment

c. Install Differential Assembly and Steering Brakes in Housing.

(1) **INSTALL LOWER BRAKE SHOES IN CASE.** Place two connected brake shoes of each steering brake assembly in housing (fig. 57). The lower end of support rods connected to the rear brake shoes slip into the guide rod clips. Place springs on rods above clips, then place support yokes on rods. Insert castle nuts into slots in yokes and start nuts onto rods by turning nuts with yokes. Then screw stabilizer bolts with jam nuts installed against head, through top of case and into yokes.

(2) **INSTALL DIFFERENTIAL ASSEMBLY IN CASE.** Attach lift chain and hoist as shown in figure 35 and lower differential assembly into case (bevel gear towards left side of case) until differential bearings are in line with holes in sides of case. Add enough shims to those that were removed with each carrier so shims installed with carrier on gear end total 0.0125 inch in thickness. The shims installed with carrier on other side total 0.080 inch and install differential bearing carriers (fig. 34) on same sides of case from which they were removed, attaching them to case with six drilled head cap screws in each. Oil pockets in carriers must be up when installed. After tightening cap screws, remove lift chain and test for correct bearing adjustment by rotating assembly with pull on

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A—BRAKE SHOE YOKE
B—BRAKE SHOE SPRING
C—BRAKE SHOE AND BELL
 CRANK PIN
D—WASHER
E—BRAKE SHOE ANCHOR PIN
F—STEERING BRAKE ANCHOR
G—BRAKE SHOE ADJUSTING NUT
H—BRAKE SHOE AND BELL CRANK
 CONNECTING LINK
I—BRAKE CONTROL BELL CRANK
J—YOKE PIN
K—BRAKE CONTROL ROD, LEFT
L—BRAKE CONTROL ROD, RIGHT
M—JAM NUT

N—ROD YOKE
O—BRAKE LEVER
P—LOCK WIRE
Q—STABILIZER BOLT
R—LOCK NUT
S—BRAKE SHOE SUPPORT ROD YOKE
T—NUT
U—CLAMP BOLT
V—SUPPORT ROD SPRING
W—SUPPORT ROD GUIDE CLIP
X—BRAKE SHOE SUPPORT ROD
Y—SUPPORT ROD PIN
Z—BRAKE SHOE
AA—BRAKE LINING
AB—BRAKE SHOE COUPLING PIN

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Figure 59 — Steering Brake Assembly — Sectionalized View

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spring scale (fig. 58). These bearings require a preload of from 15 to 25 inch-pounds. Adjustment for this preloading is made by adding or removing shims under bearing carriers. Do not install lock wire in heads of carrier cap screws until after transmission and differential are connected and bevel gear has been adjusted to bevel pinion.

(3) **INSTALL BRAKE ANCHORS, BELL CRANKS, AND UPPER BRAKE SHOES.** Connect lower ends of brake shoe yokes to front brake shoes with yoke pins and cotter pins, and slip springs onto yokes. Cement new gaskets to anchor openings in differential case and insert anchors through holes (fig. 33). Maneuver each anchor, bell crank, and yoke connected to brake shoe so that the yoke slips through hole in anchor pin as anchor pin is inserted through upper hole of anchor and through bell crank. Attach each anchor to case with six cap screws with lock washers. Install wire bracket on attaching cap screw of right anchor (fig. 32). Start brake shoe adjusting nuts on brake shoe yokes. Connect brake shoe and bell crank connecting links to upper brake shoes with coupling pins and cotter pins, then connect rear ends of upper shoes to rear shoes in same manner. Insert brake shoe and bell crank pins through anchors, connecting links, and bell cranks and secure pins with flat washers and cotter pins at both ends of pins. Push short brake shaft through case and install inner lever on inner end of shaft with end of lever pointing in opposite direction from outer lever. Install and tighten clamp screw and secure screw with lock wire. Connect ends of the shorter of two brake rods to inner lever on left brake shaft and bell crank with yoke pins and cotter pins (fig. 32). Connect the longer rod to right bell crank and inner lever of right brake shaft.

20. ASSEMBLY OF TRANSMISSION.

a. **Assemble Overrunning Clutch** (fig. 31). Place spring over cam and hook one end into hole in cam. Place cage over spring and cam and hook upturned end of spring into hole in cage. Then turn cage in clockwise direction until prongs in face of cage enter notches in cam. Install cage retaining snap ring in groove in end of cam. Place rubber band around cage, then insert rollers into cage. The rubber band will hold them from dropping out. Roll cage and rollers clockwise so rollers are on lowest point of cams and place outer race over rollers, splined end up. Remove rubber band after outer race is started over rollers. Hold race from slipping off and turn assembly over. Install gear on cam with six cap screws. After cap screws have been tightened, secure them from loosening with lock wire through cap screw heads.

b. **Install Reverse Idler Shaft and Gear** (fig. 45). Insert end of idler shaft with flat side through front end of case far enough to

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place thrust ball bearing on end of shaft (side with wider edge of outer race towards gear). Lubricate reverse idler gear bushings or bearings, then hold gear in case with spiral gear towards rear of case and slide shaft through gear, then slip thrust washer onto end of shaft with grooved side of washer towards gear and lug of washer engaging groove in shaft. Slide shaft on into rear end of case. Aline hole in side of front end of shaft with notch in case, insert lock ball in hole in shaft (fig. 30) and tap shaft in until flush with case. If idler gear being installed is equipped with needle roller bearings, a dummy shaft will be needed to assemble rollers, spacer, and washers in gear and will be pushed out of gear as idler shaft is pushed through gear and must be removed from case. If new bronze bushings have been installed in gear, they must be reamed for a free rolling fit with shaft before gear is installed.

c. **Install Input Shaft Assembly** (fig. 45). Using puller (41-P-2905-60) or press, install front bearing on input shaft. Install snap ring in groove of shaft next to bearing. Insert splined end of shaft through smaller hole in front end of case, then place parts in following order on shaft as it is pushed further into case: 24-toothed creeper pinion with shifter collar towards front of case, 27-toothed low range pinion with longer end of hub towards rear of case, pinion spacer, 48-toothed high range pinion, with spiral teeth pointing in same direction as low range pinion teeth, and thrust washer with beveled side towards rear of case. Then push shaft on through until bearing on end of shaft is started into front of case. Install split lock ring in groove in splines between creeper pinion and low range pinion, then move low range pinion against ring until ring enters counterbore in side of low range pinion. Hold shaft and gears in position while another man slips rear bearing onto rear end of shaft (snap ring groove side of bearing out) and taps it into place in case far enough to install lock washer and start lock nut onto threads of shaft. Install snap ring in bearing groove. Turn out to draw bearing into place on shaft, watching at same time to make sure split lock ring remains in place in groove of shaft and counterbore of low range pinion. After bearing has been drawn tight on shaft, tap shaft toward front of case until snap ring is tight against case. Bend prongs of lock washer into slot in nut.

d. **Install Bevel Pinion Shaft Assembly** (fig. 44).

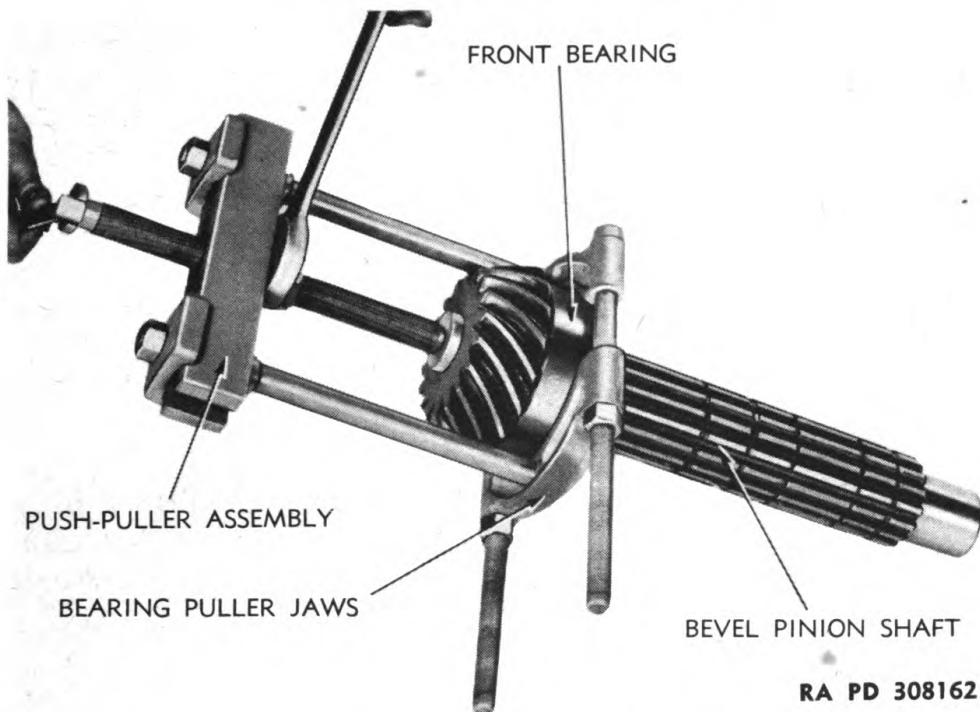
(1) **INSTALL SHAFT AND GEARS.** Using arbor press or puller (41-P-2905-60), install front bearing on pinion shaft against pinion. Expand snap ring with expander tool B-283303 shown in figure 24 and slip snap ring and tool onto shaft and remove tool to lower snap ring into groove in splines next to bearing. Insert rear end of shaft through hole in front end of case and slide parts in the following order onto shaft as it is pushed through case: 52-toothed

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creeper gear with shifter collar towards front of case, creeper gear splined shaft washer with counterbored side towards gear, overrunning clutch assembly with gear towards rear of case, low range gear splined washer with oil grooves towards overrunning clutch assembly, a second snap ring (expanded with tool), range shifter gear with long end of gear away from overrunning clutch, and high range gear splined washer with counterbored side towards rear of case, 21-toothed high range gear, and thrust washer with small machined face towards rear of case. Start front bearing on shaft into case and tap on shaft until rear end of shaft is started into rear bearing. Then slide creeper gear on shaft to front of case, slide all other gears towards rear of case, and install split lock ring in groove in splines of shaft behind creeper gear. After the two halves of the split lock ring have been placed in groove, slide the splined washer over to cover lock ring. Slide overrunning clutch assembly against splined washer and slide the next splined washer against overrunning clutch. Then move snap ring with expander tool still installed against washer and remove expander tool to let snap ring enter groove in shaft splines next to washer. Slide range shifter gear into mesh with overrunning clutch gear, then install a second split lock ring in groove in shaft splines and slide splined washer over lock ring. Slide high range gear against washer, then hold all gears together while another man taps rear bearing into place in case and onto shaft. Install shims over outer bearing race, adding enough shims to those removed in disassembly to make a total of 0.100 inch in thickness and install snap ring into groove before tapping this bearing into place in case. Install speedometer drive gear with counterbored face over end of shaft and against bearing, then install three drilled head cap screws and secure with lock wire after they are tightened.

(2) **MAKE INITIAL BEVEL PINION ADJUSTMENT.** Install speedometer drive housing temporarily with six cap screws and tighten cap screws firmly. Then look on the end of the bevel pinion for a dimension which is stamped there and designates the distance the end of the pinion is to set from the center of the bevel gear when the transmission and differential assemblies are connected. Assume that this dimension is 5.702 inches. When the transmission and differential assemblies are connected with gaskets between the two cases, the machined surfaces on the front side of the transmission case will be approximately 10.005 inches from the center of the bevel gear. Therefore, the end of the bevel pinion must extend 10.005 less 5.702 or 4.303 inches out from the machined surfaces on the front side of the transmission case. Use a straightedge laid across the end of the pinion to check this measurement. Remove the speedometer drive housing and add shims behind snap ring on rear bearing if pinion extends out of case too far or remove shims if it does

TRANSMISSION AND DIFFERENTIAL



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Figure 60 – Installing Bevel Pinion Shaft Front Bearing

not extend out of case far enough. It will be necessary to drive pinion shaft and bearings back a short distance to remove the snap ring to add or remove shims. Use a block of wood and hammer for this purpose. The pinion will be moved out again when the speedometer drive housing is again installed and the cap screws tightened. Further adjustment of the bevel pinion may be required after the transmission assembly is attached to the differential housing to obtain correct tooth contact between the pinion and bevel gear (par. 21 c).

e. Install Shifter Shafts and Forks. Insert smooth end of creeper gear shifter shaft (longest of the three) through hole in rear of case closest to power take-off side of case, place lower end of creeper gear shifter fork in collar of creeper pinion, and slide shaft through fork and partly into front end of case. Turn shaft so flat side of shaft is down. Slip two shaft plungers with a plunger spring between them into lateral passage in cases at side of creeper gear shifter shaft. Figure 46 shows arrangement of shifter shafts, forks, and plungers. Holding pressure against projecting plunger (fig. 63), slide shaft further until plunger is felt to engage lock notch in side of shaft. Next insert reverse shifter shaft which has notches in both sides and tap through center hole at rear of case. Place lower end of reverse gear shifter fork in collar of creeper gear with offset at top of fork toward rear of case and slide shaft through fork and into front end of case

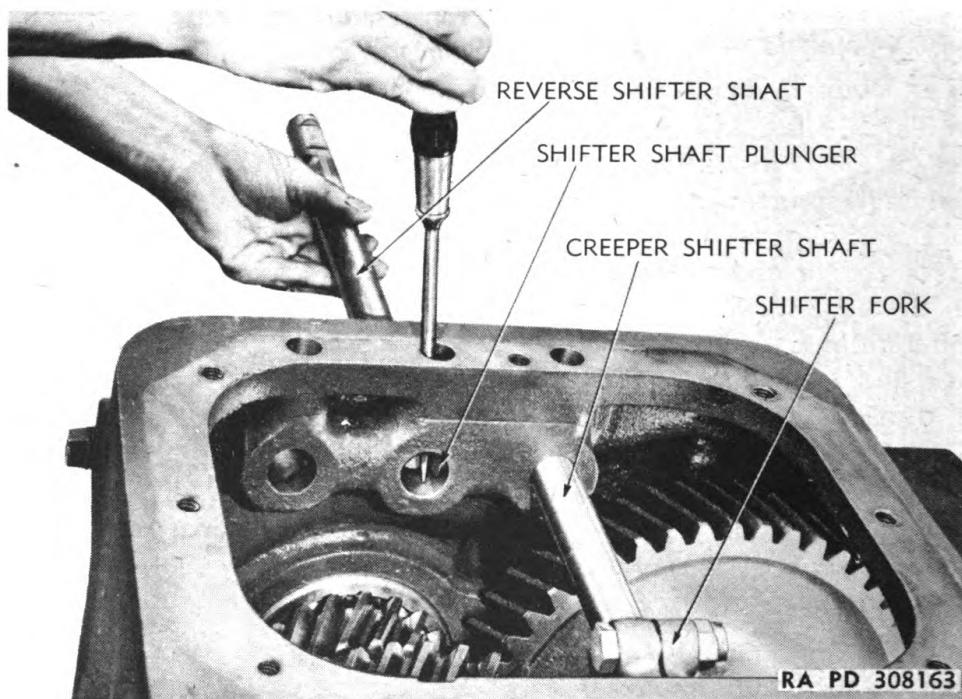
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Figure 61 – Shifter Shaft Installation

until locking notch in one side of shaft engages plunger and inner notch on top side of shaft can be seen through top hole in case. Install two more shaft plungers with spring between them in lateral passage next to shifter shaft just installed in same manner as before. Insert high and low shifter shaft through remaining hole in case. Place high and low shifter fork in collar of range shifter gear with longer side of hub in fork towards rear of case and slide shaft through fork and into front of case until lock notch in side of shaft engages plunger. After bevel pinion has been adjusted to differential bevel gear, adjust forks on shafts so full and proper meshing of gears will be effected when shifted as explained in subparagraph f, following.

f. Adjust Shifter Forks. After bevel pinion has been adjusted to bevel gear, move high and low gear shifter shaft until front lock notch in top side of shaft can be seen in center of top hole in case. Hold shaft in this position and slide range shifter gear into full mesh with high range gear. Tighten clamp bolt in shifter fork. Slide range shifter gear into neutral position, then move center shifter shaft until front lock notch in top of shaft can be seen in center of top hole. Slide creeper gear into full mesh with gear teeth on outer race of overrunning clutch assembly, then tighten clamp bolt in fork. Slide creeper gear into neutral position and move creeper gear shifter shaft until lock notch in top of shaft can be seen in center of top hole.

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Tighten clamp bolt and install cotter pins in all three clamp bolts. Tap the three shifter shaft covers into case over rear ends of shafts.

21. ASSEMBLY OF COMPONENTS INTO POWER TRAIN.

a. **Connect Transmission to Differential.** Cement new gaskets to rear of differential housing and end of reverse idler shaft and, with use of hoist, move transmission assembly into position against differential, inserting bevel pinion through hole in differential housing and meshing pinion with bevel gear. One of the pinion teeth has a mark at rear end of tooth. This tooth must engage between 2 teeth on the bevel gear that are similarly marked. Attach transmission to differential with 10 cap screws and lock washers around outside of case and 2 drilled head cap screws secured with lock wire at top edge of transmission case (fig. 18).

b. **Install Speedometer Drive Assembly.** A small oil piping connector is pressed into the speedometer drive housing and has a small sealing ring similar to a piston ring in a groove towards inner end of shaft (fig. 66). When drive assembly is installed, the end of connector and sealing ring enters the bore of speedometer drive gear. The sealing ring must have a gap of 0.002 to 0.003 inch and fit freely in groove, and shaft must slip freely into gear to prevent gear from freezing to shaft during operation. Attach housing to transmission case with six cap screws with lock washers (fig. 17).

c. **Adjust Bevel Pinion and Bevel Gear.**

(1) **ADJUST FOR CORRECT TOOTH CONTACT OF PINION WITH GEAR.** Change shims behind differential carriers as explained in following step (2) to obtain 0.012- to 0.015-inch backlash between bevel pinion and gear. Coat several of the bevel pinion teeth with Prussian blue or similar material, engage the creeper pinion with creeper gear, and turn the transmission input shaft in a clockwise direction. Then observe the blue marks left on the bevel gear teeth by the pinion. The most desirable tooth contact area when tested in this manner is from the center of the tooth to the inner end as shown in figure 62. It will not always be possible to obtain this contact, however, the pinion may be moved in or out a maximum of 0.080 inch to obtain as nearly correct contact as possible by the removal or addition of shims behind snap ring on rear pinion shaft bearing as explained in paragraph 20 d (2). To move pinion and bearings back for removal of the snap ring, insert pry bar between the end of the pinion and one of the center sections of the differential compensating case. **CAUTION:** *Do not pry against the differential pinions.* Speedometer drive housing must be installed and cap screws tightened each time before checking above adjustment.

(2) **ADJUSTMENT OF BEVEL GEAR TO PINION.** After bevel pinion has been adjusted for proper tooth contact with bevel gear, the bevel gear must be adjusted to allow 0.005- to 0.012-inch backlash between pinion and gear at tightest point.

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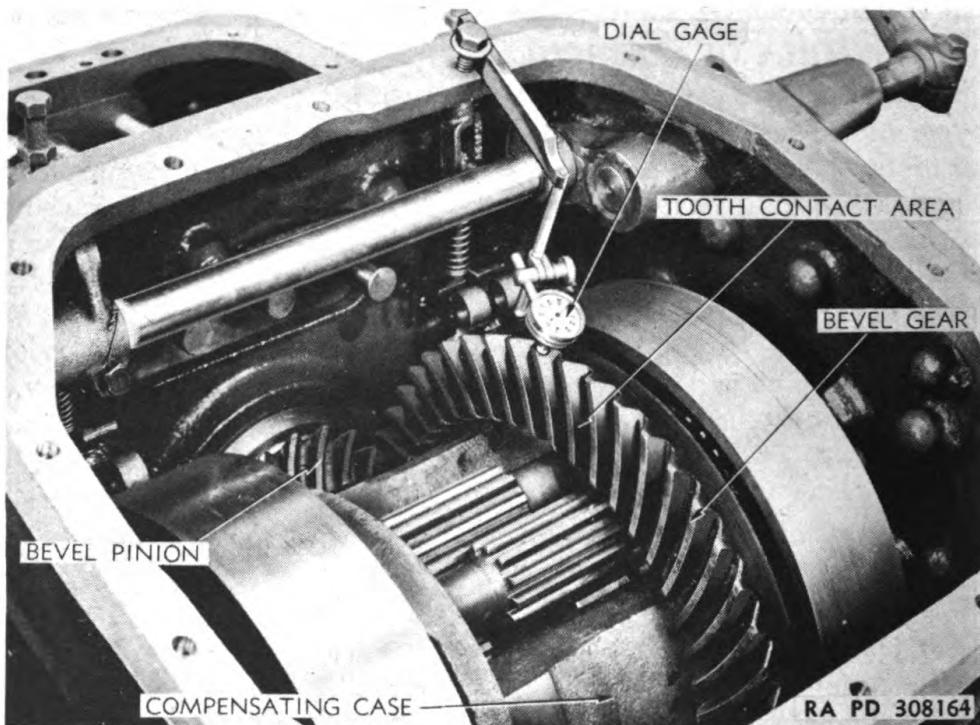


Figure 62 – Bevel Pinion and Gear Adjustment, Using Dial Indicator (41-I-100)

Mount a dial gage on differential case as shown in figure 62 to check backlash, then adjust gear to pinion by changing shims under differential bearing carriers from one side to the other until correct adjustment is obtained. If there is too much backlash, remove shims from left bearing carrier and add the same shims removed to those under right bearing carrier. If there is not enough backlash, shims must be removed from right bearing carrier and these same shims added to those under left bearing carrier. This procedure must be used so the adjustment of the differential bearings will not be changed. The cap screws in differential bearing carriers must be tightened firmly after shims are changed before backlash is checked. After correct adjustment of backlash is obtained thread lock wire through heads of differential bearing carrier cap screws.

d. Install Shifter Shaft Extensions. Install shifter shaft extensions on front ends of transmission shifter shafts as shown in figure 63. Position extensions so they are flush with ends of shaft, then tighten clamp bolts and install cotter pins in bolts. Adjust shifter shafts as explained in paragraph 20 f. With all gears in neutral position (fig. 12), the notches in extensions on reverse (center) and creeper (left) shifter shafts should now be even. Adjust creeper shaft exten-

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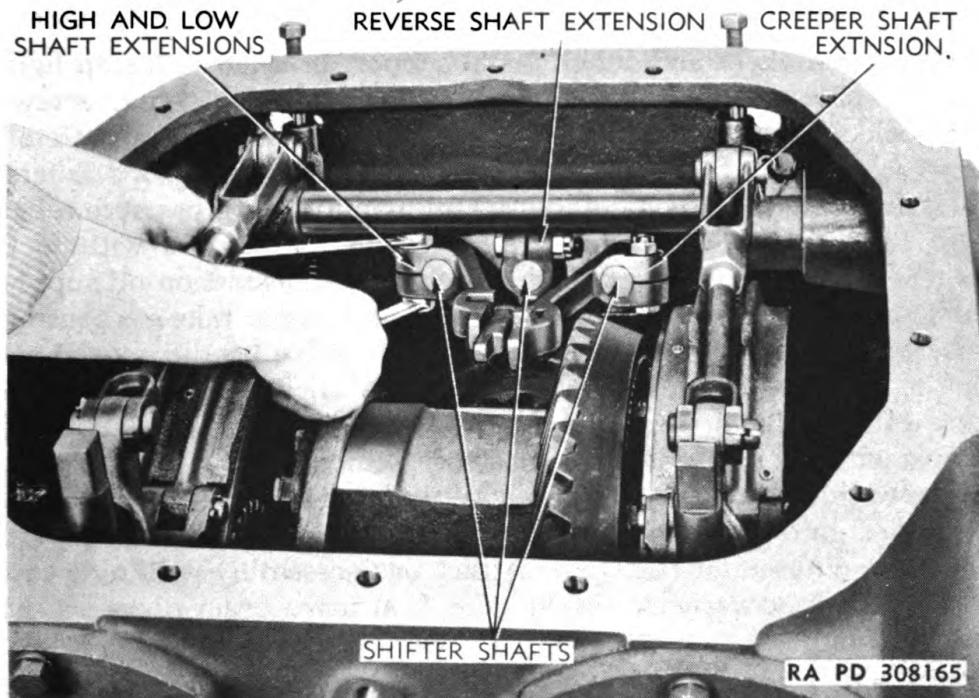


Figure 63—Installation of Shifter Shaft Extension

sion if necessary. Then slide reverse shifter shaft back until lock plunger engages next notch in rear end of shaft and observe if notch in high-low range shifter shaft extension is even with notch in reverse shifter shaft extension. Adjust extension on high-low shaft if necessary. Test to make sure gears shift easily and mesh fully with mating gears or pinions.

e. Install Covers and Transmission to Torque Converter Adapter (fig. 17). Make sure all necessary cotter pins and lock wires are installed, then cement cover gasket to differential case and install cover assembly with 14 cap screws with lock washers. The end of the gear shifter lever in cover should be inserted into notches in shifter shaft extensions as cover is put in place. Install a shifter shaft plunger, spring, and spring seat in each of the three holes in top of rear side of transmission case (fig. 18), then cement gasket to case and install cover with 9 cap screws with lock washers. Cement gasket to rear end of transmission case and install transmission to torque converter adapter with 6 cap screws with lock washers. Flat side of adapter should be turned towards speedometer drive housing.

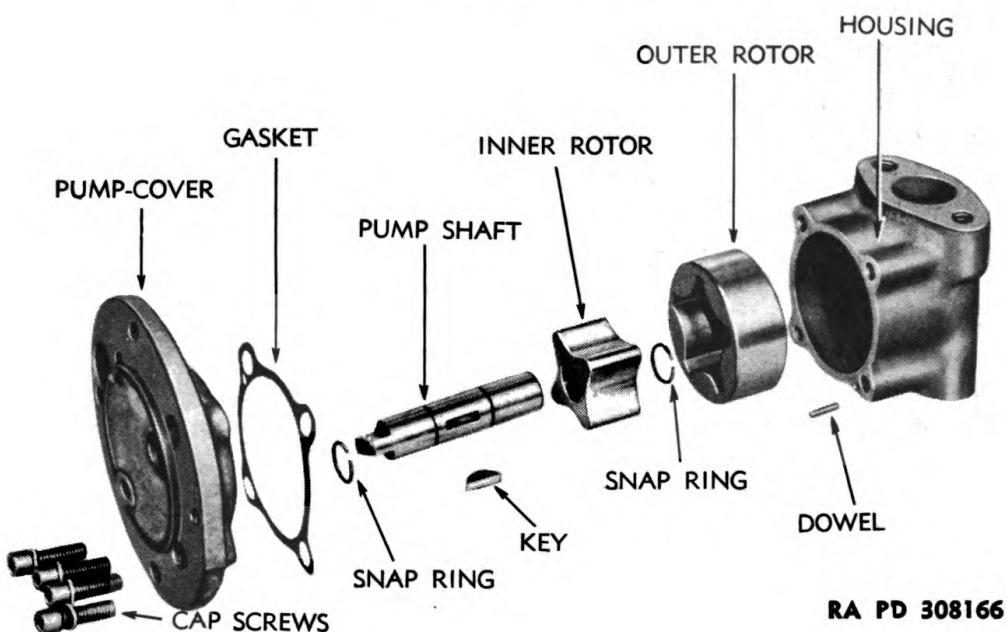
f. Install Power Take-off and Final Drive Assemblies. Cement gasket to transmission case and install power take-off assembly with transmission oil pump on case with eight cap screws with lock washers (fig. 13) leaving cap screw out of top front hole at present. Attach

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steering brake lever and clutch pedal support bracket with stop light switch to side of differential housing (fig. 15) with three cap screws with lock washers. Install oil supply manifold on transmission oil pump as shown in figure 13 with three cap screws with lock washers. Using new gaskets, attach differential oil manifold with pressure relief valve to rear of differential case with four cap screws with lock washers (fig. 13). Connect hoses attached to transmission oil supply manifold to fittings on speedometer drive and power take-off housing as shown in figure 13 and to pressure relief valve on differential oil manifold and fitting to transmission reverse idler shaft as shown in figure 14. Attach clip on last named oil hose to front of power take-off housing with cap screw and lock washer. Cement final drive attaching gaskets to sides of differential case. With aid of hoist, raise final drive assemblies into position against differential case, inserting pinion shafts into differential (fig. 16). Attach each assembly with nine cap screws with lock washers. Make sure final drive drain plugs are in place and tight.

g. Install Controls and Oil Lines. Place steering lever assembly in place against final drive spacer, inserting end of lever shaft into support bracket on differential case (fig. 15) and attach support to spacer with four cap screws with lock washers. Connect ends of rods at lower ends of levers to levers on brake shafts with yoke pins and cotter pins. Connect rod on power take-off lever to shifter shaft of power take-off. Connect brake springs (fig. 14). Install bayonet gage in differential cover. Raise entire assembly from stand with hoist to permit installation of oil sump at bottom of differential case. Install oil sump gasket, screen, a second gasket, and oil sump (fig. 49) at bottom of case with five cap screws with lock washers. Install and tighten magnetic drain plug. Using new gaskets, install suction pipe connecting one end to sump, the other to bottom of transmission oil pump (fig. 13). Unless the assembled unit is to be immediately installed, cover all exposed openings with adhesive paper and attach a tag in a conspicuous place stating that steering brakes will require adjustment. Note also that differential case and final drive cases are to be filled with lubricant after unit is installed in vehicle. Adjustment of steering brakes is outlined in TM 9-785.

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Figure 64 — Transmission Oil Pump Disassembled

Section V

TRANSMISSION OIL PUMP

22. DESCRIPTION AND OPERATION.

a. The transmission oil pump is a precision-built, rotor-type pump mounted on the rear of the power take-off housing (fig. 13). It is driven by a tongue in the pump shaft engaging a groove in power take-off shaft. Its purpose is to circulate the oil from the transmission and differential through the oil cooling radiator and distribute it to various parts of the transmission and differential. The pump draws the oil from the oil sump in bottom of differential housing. The oil discharged from the pump passes into a supply manifold above the pump. Oil hoses leading to the speedometer drive housing, transmission reverse gear, torque converter, and power take-off are connected to this manifold. A small portion of the oil passes through these hoses to lubricate those assemblies. The balance is discharged through another line to the cooling radiator where it is cooled and returns to the manifold on the rear of the differential case and is distributed to parts of the differential. Pressure in the system is maintained by a short restrictor pipe located next to rear end of hose in the discharge oil line leading from pump to radiator. A pressure relief valve (par. 24) located in an oil line connecting the oil supply manifold to the differential manifold (fig. 14) is provided allowing the oil to bypass directly from the pump and supply manifold to the differential in the event the cooler lines become clogged.

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23. MAINTENANCE.

a. Under normal operating conditions this pump should require no attention. If loss in pressure is noted, the line connections should be checked for tightness and the relief valve (par. 24) and should be inspected to see that it is not held open. If the pressure is not improved, the pump must be replaced as a complete unit. No adjustment is provided in this pump assembly as all clearances are held accurately within the pump. If operating properly, the pump should deliver 16 gallons per minute at 2,050 revolutions per minute under 40 pounds per square inch pressure and with SAE50 oil at 150° F. Mount the pump in test stand to check its efficiency and determine its condition.

Section VI

TRANSMISSION OIL PRESSURE RELIEF VALVE

24. DESCRIPTION.

a. The transmission oil pressure relief valve is located at left end of differential oil manifold (fig. 14). It is a spring-and-plunger-type valve contained in a housing and is adjustable for various opening pressures. It is connected by a hose to the oil supply manifold above transmission oil pump. This valve allows the transmission oil to bypass directly back into the differential if excessive pressure develops in the transmission and differential lubricating system due to clogged oil passages or thick oil.

25. DISASSEMBLY AND INSPECTION OF VALVE.

a. **Result of Sticking Valve.** Low transmission oil pressure can be due to the piston of valve sticking in open position. Disassembly of the valve is necessary to free the valve or replace defective parts.

b. **Disassemble Valve.** Unscrew acorn cap from adjusting screw and lift gasket off screw. Loosen lock nut and turn adjusting screw out of valve body. Turn retainer nut out of body and jar spring and valve piston out of body.

c. **Inspection of Parts.** Wash all parts with dry-cleaning solvent and dry with compressed air. Soak parts if necessary to remove gummy substances. Discard valve piston or valve retaining nut if worn, corroded, or scored. Replace spring if it is cocked or broken.

26. ASSEMBLY AND ADJUSTMENT.

a. Lubricate valve piston and insert piston into longer end of body against valve seat. Drop spring into piston, then screw valve

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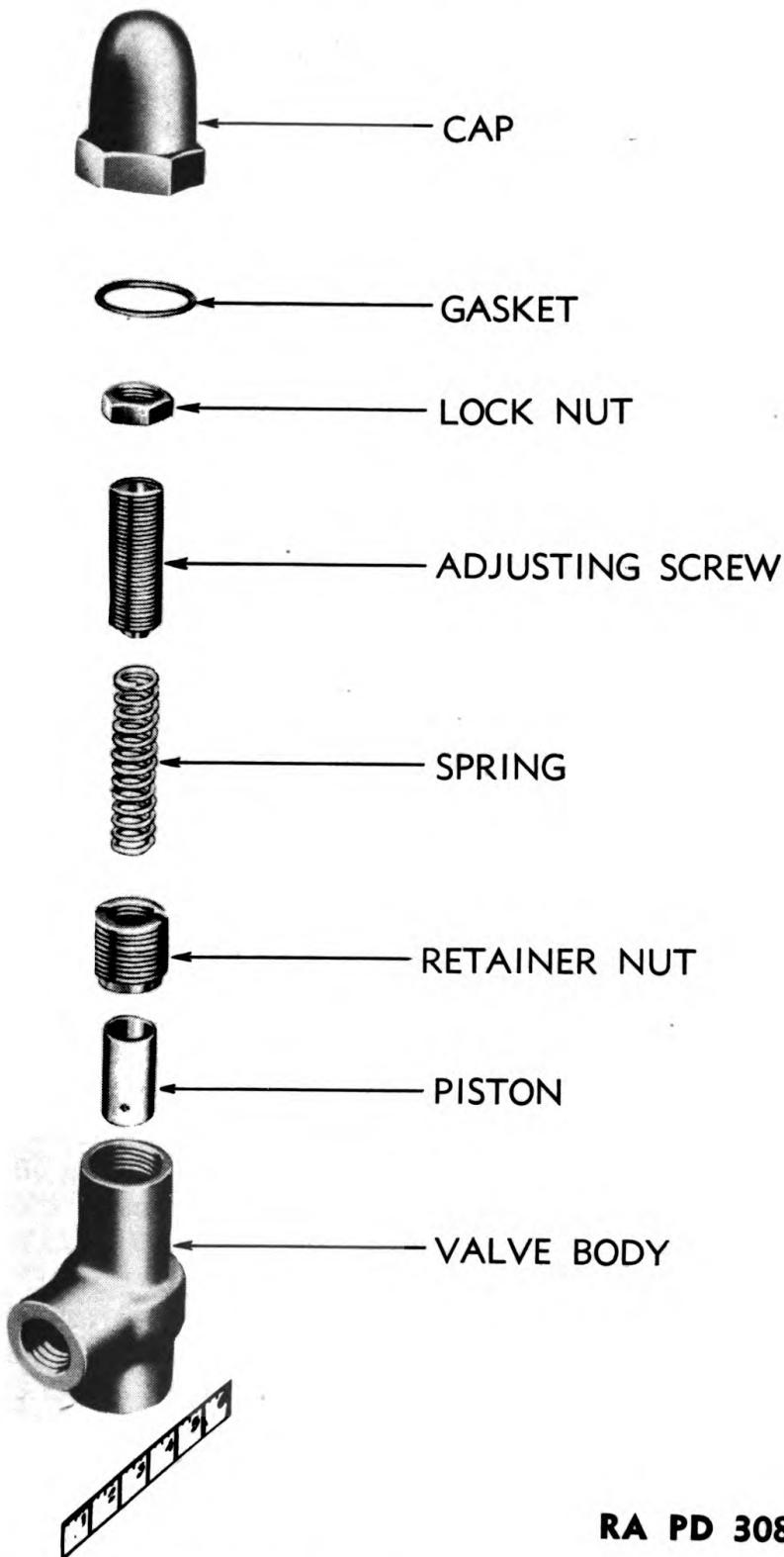


Figure 65 – Transmission Oil Pressure Relief Valve Disassembled

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retainer nut into body around spring and turn nut in until tight. Start adjusting nut into valve retainer nut. Adjustment for an opening pressure of 60 pounds per square inch must now be made. Screw a pipe nipple into end of valve body opposite valve. Screw a tee-fitting onto nipple, then install an oil pressure gage in side of tee-fitting and connect a pump to end of tee-fitting so oil can be pumped into valve body. Turn valve adjusting screw in or out until 60 pounds of pressure registers on gage before valve opens to allow oil to pass through valve. Then install and tighten lock nut on adjusting screw. Install copper gasket and acorn cover over adjusting screw.

Section VII**SPEEDOMETER DRIVE****27. DESCRIPTION.**

a. The speedometer drive assembly consists of a worm drive gear bolted to the rear end of the transmission bevel pinion shaft, a small driven gear and shaft in the speedometer drive housing, and a flexible drive shaft. One end of the drive shaft is connected to the driven gear shaft, the other end to the speedometer in instrument panel of vehicle.

28. REMOVAL, DISASSEMBLY, AND INSPECTION.

a. **Removal.** Unscrew the retainer nuts at ends of shaft housing from speedometer housing and drive housing and pull ends of shaft out of housing. Remove cap screws from clips on transmission and bracket under instrument panel (fig. 3) and remove drive shaft assembly. Remove drive housing assembly from rear of transmission by disconnecting oil hose, removing six cap screws, and lifting off housing assembly and shims, then cut lock wire and remove the three cap screws attaching drive gear to bevel pinion shaft (fig. 21). Pull drive gear from shaft.

b. **Disassembly.** Remove the two retaining cap screws and lift drive sleeve assembly and gasket from housing. Lift driven gear and shaft out of housing. If bushing in housing for short end of shaft is worn, it should also be removed. Drive oil piping connector out of housing if worn or damaged. Remove retaining washer from one end of flexible shaft and pull shaft out of housing.

c. **Inspection of Parts.** Wash all parts and dry with compressed air. Inspect oil piping connector to make sure the oil passages are open and unobstructed, and that sealing ring is in good condition.

TRANSMISSION AND DIFFERENTIAL

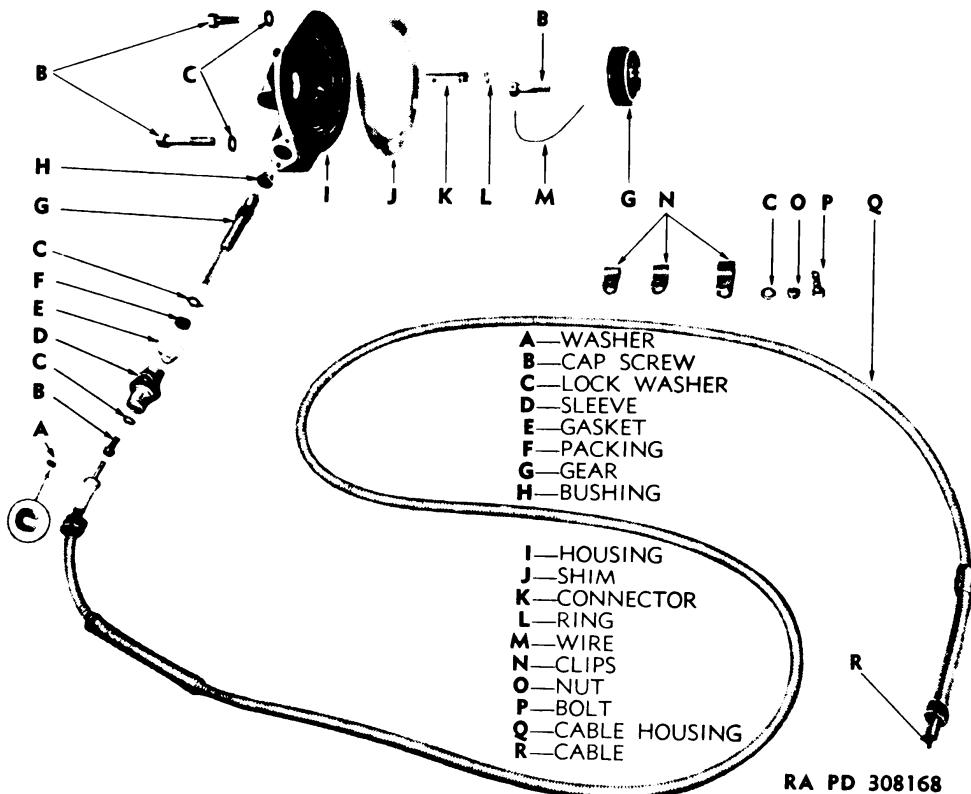


Figure 66 — Speedometer Drive Assembly Disassembled

If ring and shaft are worn, they must be replaced. This shaft must have a free fit of 0.002 or 0.003 inch with inner bore of drive gear. Replace drive gear or driven gear if teeth are damaged or worn to sharp edge. Check flexible drive shaft to make sure it turns easily in its flexible housing and that cable is not kinked or housing broken. Replace packing in drive sleeve.

29. ASSEMBLY AND INSTALLATION.

a. **Assembly** (fig. 66). Press new bushing for shorter end of speedometer drive shaft into housing, also press oil piping connector into center of housing with end of connector flush with outer side of housing. Slip drive gear onto other end of connector over sealing ring to check for 0.002- to 0.003-inch gap in sealing ring. Insert shorter end of driven gear shaft into bushing installed in housing. Install new packing and washer in drive sleeve, slip new sleeve gasket over lower end of sleeve, then install sleeve over driven gear shaft and into housing. Attach with two cap screws and lock washers. Lubricate flexible shaft, insert shaft through flexible housing, and slip retaining washer or washers on ends of shaft.

b. **Installation.** Install drive gear on end of transmission bevel pinion shaft with three cap screws, secured with lock wire after

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tightening (fig. 21). Install drive housing on rear of transmission case, inserting end of oil piping connector into inner bore of drive gear. Attach housing with six cap screws with lock washers (fig. 17). Connect oil hose to elbow in drive housing. Pass flexible drive shaft assembly under differential, and attach ends of drive shaft and housing to speedometer and speedometer drive. Install cap screws in clips to support shaft from transmission case and bracket under instrument panel (fig. 3).

Section VIII

FITS AND TOLERANCES

30. FITS AND TOLERANCES.

a. General. The dimensions listed below are manufacturing and assembly tolerances for the transmission and differential. Parts that are worn beyond these dimensions will be replaced at the discretion of commanding officers of the maintenance personnel.

b. Transmission.

Transmission reverse idler shaft (diameter) 1.747-1.748 in.

Transmission reverse idler gear bushing

(inner diameter) 1.7525-1.7535 in.

(Refer to par. 17 a (5) if gear is equipped
with needle roller bearings)

Creeper gear splined washer (thickness) $1\frac{1}{32}$ in.

Low range gear splined washer (thickness) 0.215-0.217 in.

High range gear splined washer (thickness) $1\frac{1}{32}$ in.

Bevel pinion shaft thrust washer (thickness) 0.345-0.350 in.

Input shaft thrust washer (thickness) 0.340-0.350 in.

Reverse idler thrust washer (thickness) 0.215-0.220 in.

Creeper gear shifter fork (thickness) 0.360-0.370 in.

Reverse gear shifter fork (thickness) 0.360-0.370 in.

High and low gear shifter fork (thickness) 0.360-0.370 in.

c. Differential.

Preload on differential carrier bearings 15-25 in.-lb

Brake drum hub bushings (inner diameter —

installed) 3.500-3.502 in.

Differential gears — inner (outer diameter of hub) 3.369-3.370 in.

Differential gear bushings (inner diameter —

installed) 3.375-3.377 in.

Differential pinion shafts — left

(journal bearing diameter) 1.372-1.373 in.

(journal diameter at threaded end) 1.622-1.6225 in.

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Differential pinion shafts — right (journal bearing diameter)	1.372-1.373 in.
Compensating case cover bushings — small (inner diameter)	1.3805-1.381 in.
Compensating case cover bushings — large (inner diameter)	1.6305-1.631 in.
Backlash between differential pinions and gears	0.015 in.
Backlash between outer differential pinions and brake drum hub gears	0.015 in.
Backlash between bevel pinion and gear	0.005-0.012 in.
Brake shafts (diameter)	1.247-1.250 in.
Brake shaft bushings (inner diameter)	1.251-1.253 in.

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CHAPTER 5
FINAL DRIVES

31. DESCRIPTION AND OPERATION.

- a. The final drives are, in effect, gear reduction units which transfer the power of the engine from the transmission and differential to the drive sprockets and tracks. The drive sprockets are bolted to splined sprocket shafts. The final drive gears on the sprocket shafts are driven by the final drive pinions. Splined shafts, the ends of which are inserted into the pinions and differential gears, drive these pinions. The final drive gear cases are the main support for the differential and transmission.
- b. The final drive pinion shafts and sprocket shafts rotate on tapered roller bearings. The gears and bearings are lubricated by oil carried in the gear cases and distributed by the rotation of the gears. Oil seals at outer ends of sprocket shafts prevent escape of lubricant and guard against entrance of dirt and water into the gear cases. Each seal assembly consists of two finely machined steel rings; one ring turns with shaft, the other is held stationary. A rubber seal boot and spring follower arrangement holds the machined surfaces of the two seal rings tightly against each other so that oil or dirt cannot pass between them, thus forming a seal. The drain plugs in bottom of gear case covers are equipped with small magnets to retain metal particles which might accumulate in the cases from gears or other parts.
- c. Each track drive sprocket assembly consists of a hub with a drive sprocket bolted to each end. The teeth of the sprocket engage the connectors on the track shoes.

32. REMOVAL AND DISASSEMBLY.

- a. General. The final drive assemblies may be removed as a complete unit and then disassembled or the gears, shafts, and bearings can be removed from the gear case and gear case left on tractor. To remove entire assembly complete, follow procedure outlined in subparagraph b following. To remove the shafts, gears, and bearings without removing gear case from tractor, follow procedure outlined in subparagraph c following.

- b. Removal of Complete Final Drive Assembly (fig. 68). Disconnect tracks. Remove front plate from bumper supports by removing the 22 retaining cap screws. Place blocks between bottom of hull and differential case to support weight of differential and transmission. Remove the 10 bolts that attach final drive case to bumper

FINAL DRIVES

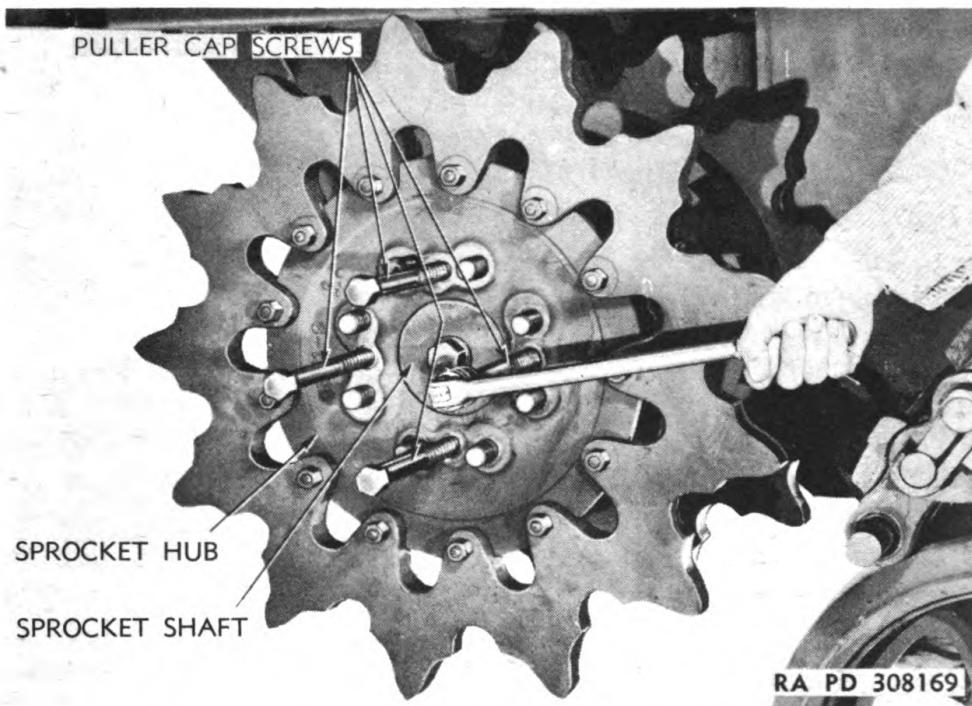


Figure 67 — Removing Sprocket Hub Assembly

support and the 6 bolts and 5 cap screws that attach spacer between gear case and differential case to final drive gear case. Take weight of final drive assembly with chain hoist, then remove the large cap screw and bolt that attaches bottom and top of gear case to front of hull frame (fig. 10). Move assembly straight away from tractor to slide pinion shaft out of differential and spacer.

c. Removal of Final Drive Gears, Shafts, and Bearings.

(1) **REMOVE SPROCKET SHAFT ASSEMBLY.** Drain oil from gear case and disconnect track. Remove the four puller hole plug cap screws from sprocket hub and install 4 puller cap screws (BCSX2CT) in their places (fig. 67). Turn these cap screws in evenly to force sprocket hub from shaft. Lift off hub. Remove front plate from bumper supports by removing 22 cap screws. Remove bottom cover from gear case by removing 12 cap screws. Remove the 6 cap screws from inner shaft bearing cap and remove the cap. Bend bearing washer bolt lock away from cap screw heads and remove the 3 cap screws (fig. 68) and the lock, bearing washer, and adjustment shims. Remove the 6 cap screws from seal guard and plate at outer hub of case, then remove the puller hole plug bolt from center of sprocket shaft and install the adapter (A-347829) for shaft puller (41-P-2957-100) (fig. 147) tightly in its place. Screw bolt of shaft puller tightly into adapter and operate sliding ram to pull shaft out of inner bearing. After shaft has been pulled out of inner bearing, remove shaft puller

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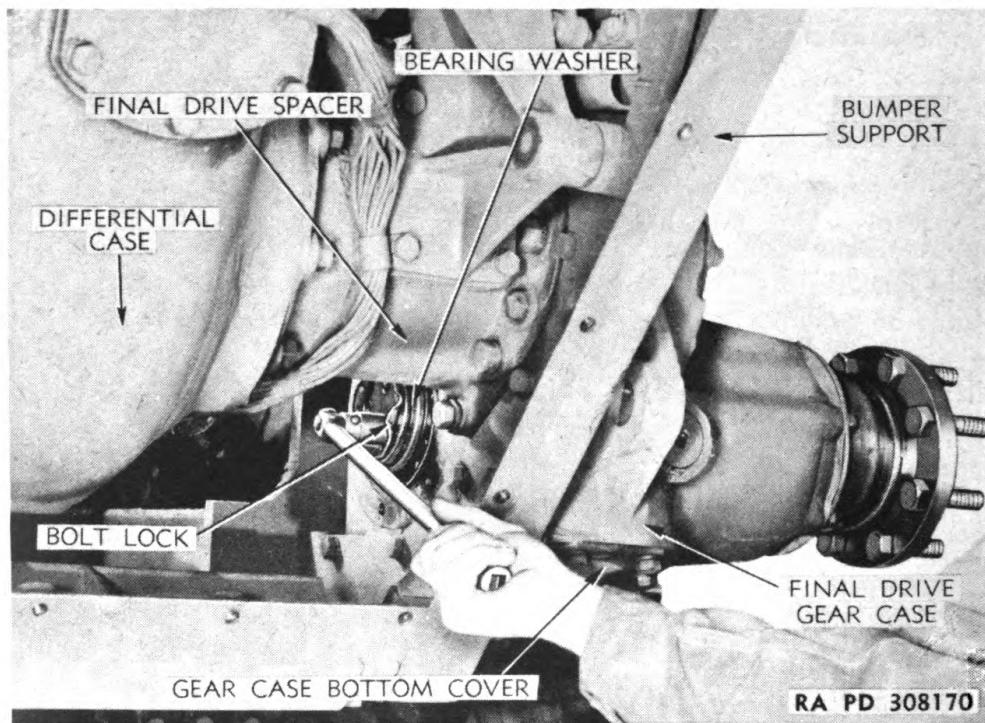


Figure 68—Removing Bearing Lock and Washer

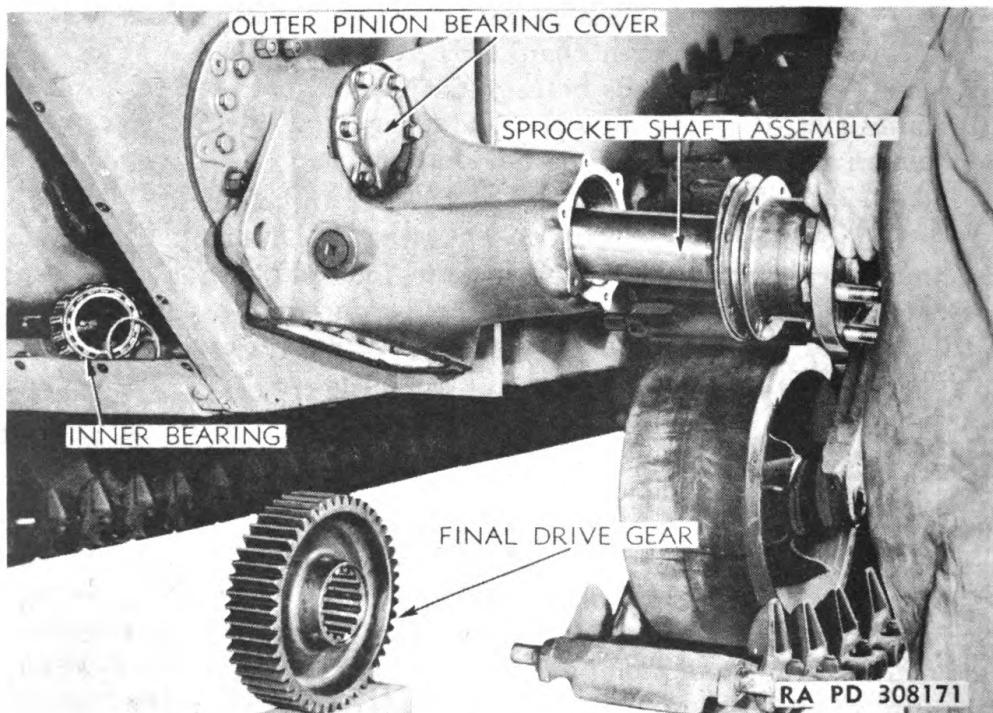


Figure 69—Removing Sprocket Shaft

FINAL DRIVES

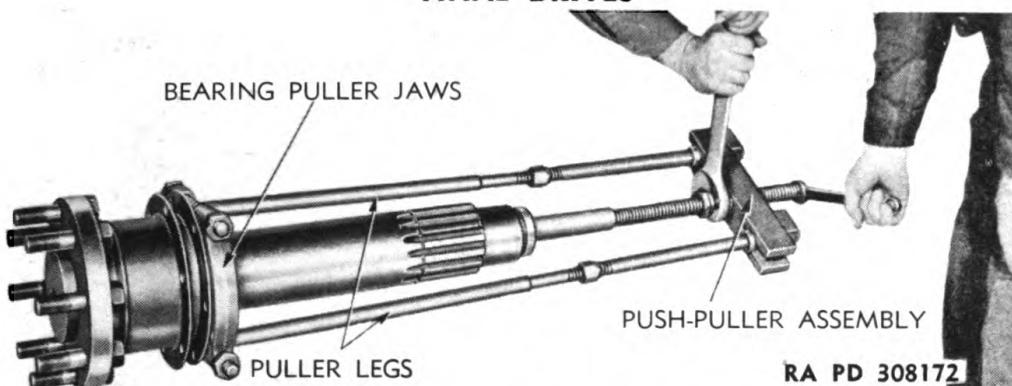


Figure 70 – Removing Inner Sprocket Shaft Bearing, Using Adapter (A-347829) and Puller (41-P-2957-100)

and, with one man supporting weight of final drive gear, slide shaft out of gear and case. Remove inner bearing, bearing spacer, and spring washer. Lower gear out of case. Remove bearing cups with puller (41-P-2905-60) as shown in figure 41.

(2) **REMOVE PINION SHAFT ASSEMBLY.** Remove outer pinion bearing cover and shims by removing six cap screws (fig. 69). Install shaft puller assembly in tapped hole in end of pinion shaft in the same way as when pulling sprocket shaft, and pull outer pinion bearing, pinion, and shaft from case. Operate sliding ram with light strokes to prevent breaking snap ring in inner splines of pinion at end of pinion shaft. Remove inner bearing cup in same manner as inner sprocket shaft bearing cup with push-puller and bearing cup puller (fig. 41). Press or pull bearings from pinion.

d. Disassembly of Sprocket Shaft Assembly.

(1) **REMOVE OUTER BEARING** (fig. 70). Install bearing puller jaws back of bearing, wedging jaws against shaft, then connect puller legs and push-puller as shown in illustration, and pull bearing from shaft.

(2) **REMOVE OIL SEAL ASSEMBLY.** Lift seal plate and follower assembly with one seal ring and seal guard from shaft (fig. 73), then drive dowels through flange on end of shaft from outer side, far enough to loosen second seal ring and remove seal ring. If necessary to replace any of the sprocket hub bolts, remove snap ring (fig. 74) and drive bolts out of flange.

33. CLEANING AND INSPECTION OF PARTS.

a. **Cleaning.** Wash all parts, with the exception of the seal boot, with dry-cleaning solvent and dry with compressed air. Wash seal boot with a cloth soaked with clean, light engine oil.

b. **Inspection.** After all parts have been thoroughly cleaned, inspect them for damage and wear as follows:

(1) **GEARS.** Examine gears for cracks, checks, or broken teeth.

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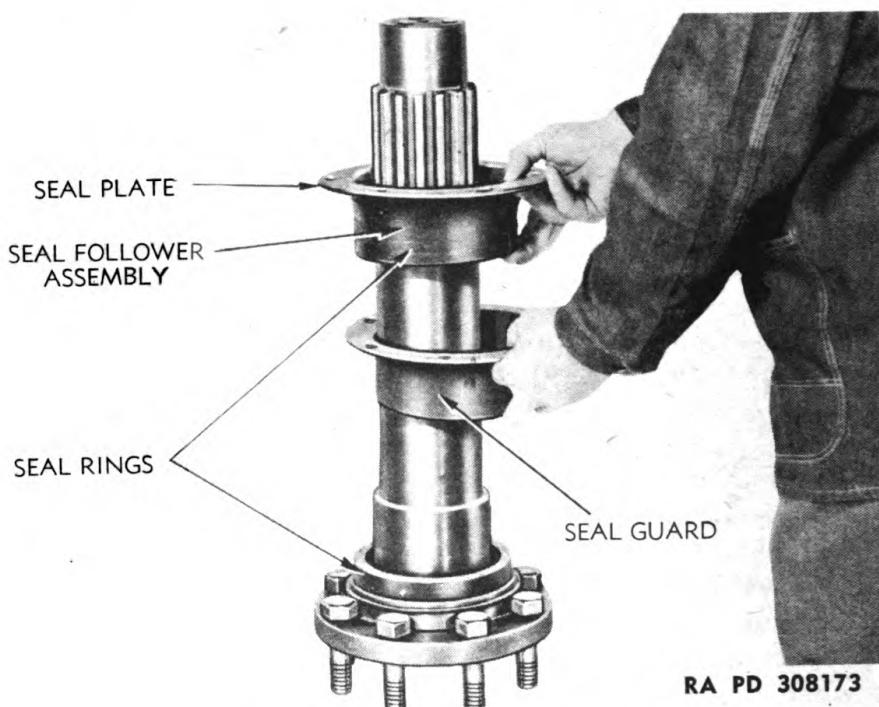


Figure 71—Removing Oil Seal Assembly

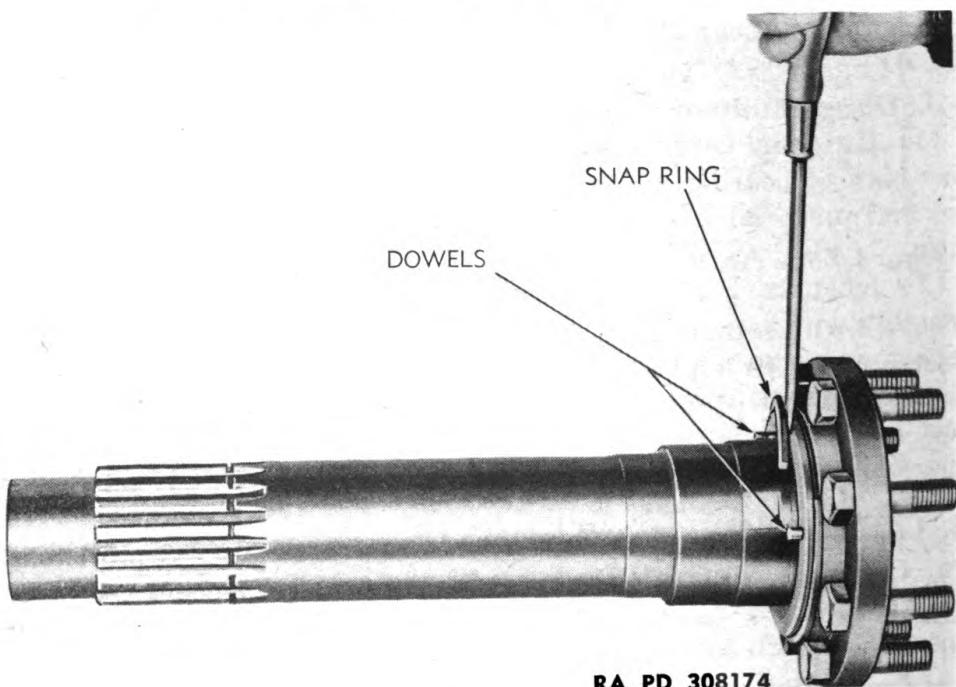


Figure 72—Removing Sprocket Hub Bolt Retaining Snap Ring

FINAL DRIVES

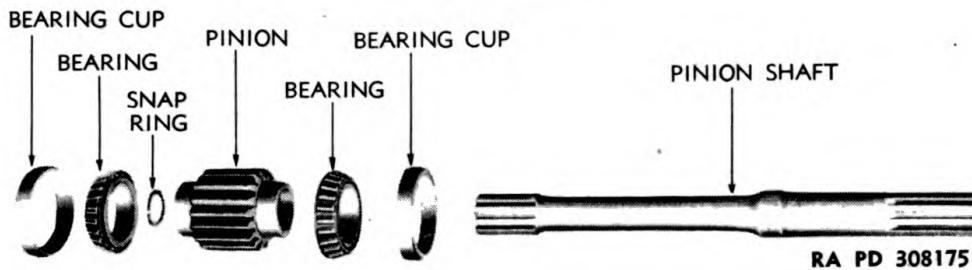


Figure 73 — Final Drive Pinion Shaft and Bearings Disassembled

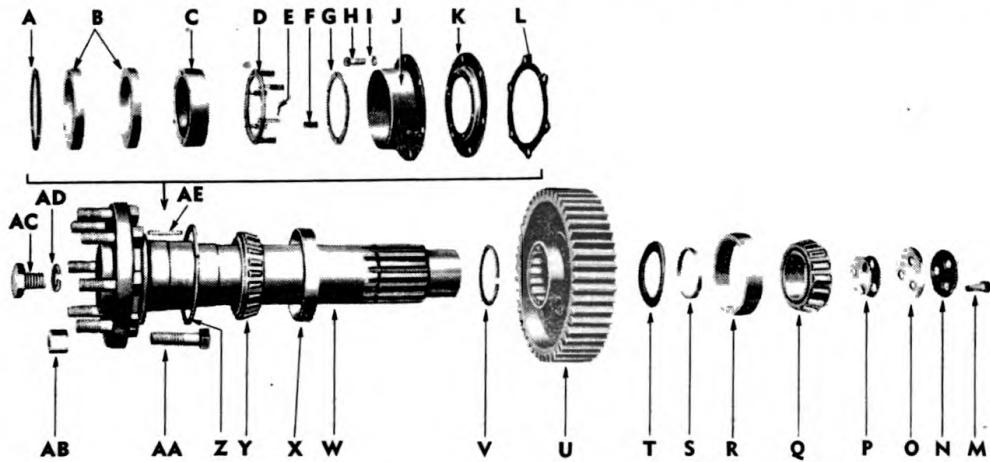
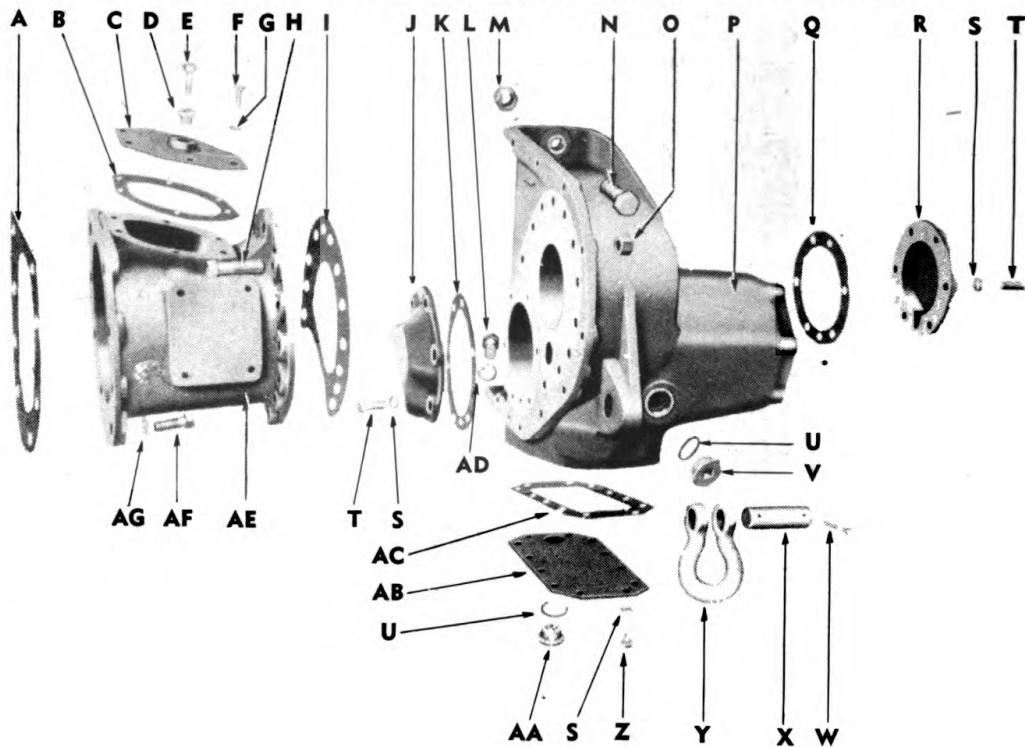


Figure 74 — Final Drive Sprocket Shaft Assembly Disassembled

Gears with teeth worn to a sharp edge or with chipped or broken teeth, should be replaced. Inspect pinion and shaft. Check to make sure that shaft is not worn and that bearings fit snugly on shaft. Inspect splines in both pinion and shaft. Replace pinion shaft if splines are damaged. File or grind off all burs on gears or shaft splines.

(2) BEARINGS. Rotate bearings slowly by hand, inspecting for rough, chipped, or discolored rollers or races. Discard any that do not have smooth and brightly polished surfaces on rollers or races. Discoloration is usually evidence of bearing having been overheated in operation.

(3) OIL SEALS. Sealing surfaces of the seal rings should be perfectly smooth and flat to effect a good seal. Replace both seal rings if either ring is scored or damaged. Check to see if any dowels that

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A—GASKET	L—CAP SCREW	W—COTTER PIN
B—COVER GASKET	M—NUT	X—SHACKLE PIN
C—SPACER COVER	N—BOLT	Y—TOWING SHACKLE
D—PIPE BUSHING	O—NUT	Z—CAP SCREW
E—BREATHER	P—FINAL DRIVE HOUSING	AA—DRAIN PLUG
F—CAP SCREW	Q—SHIM	AB—HOUSING COVER
G—LOCK WASHER	R—PINION SHAFT CAP	AC—COVER GASKET
H—BOLT	S—LOCK WASHERS	AD—LOCK WASHER
I—GASKET	T—CAP SCREWS	AE—FINAL DRIVE SPACER
J—BEARING CAP	U—PLUG GASKETS	AF—CAP SCREW
K—BEARING CAP GASKET	V—OIL LEVEL PLUG	AG—LOCK WASHER

Figure 75 – Final Drive Housing Disassembled

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hold or drive seal rings are broken or missing. Broken dowels can be drilled and removed and new ones installed. If seal boots to be installed are dry or out of shape, dip them in boiling water and they will resume their correct shape. Replace bent seal guards or drive plates. Replace follower assemblies if twisted.

(4) DRIVE SPROCKETS. Replace cracked or badly worn sprockets. Extra wear may be obtained from worn sprockets by switching sprockets from one side of hub to the other when installing them so wear will be on opposite side of teeth.

(5) GEAR CASE AND SPACER. Repair cracked or broken housing if possible, if not, replace. Clean magnetic drain plug and test magnetism of small magnet in plug.

FINAL DRIVES

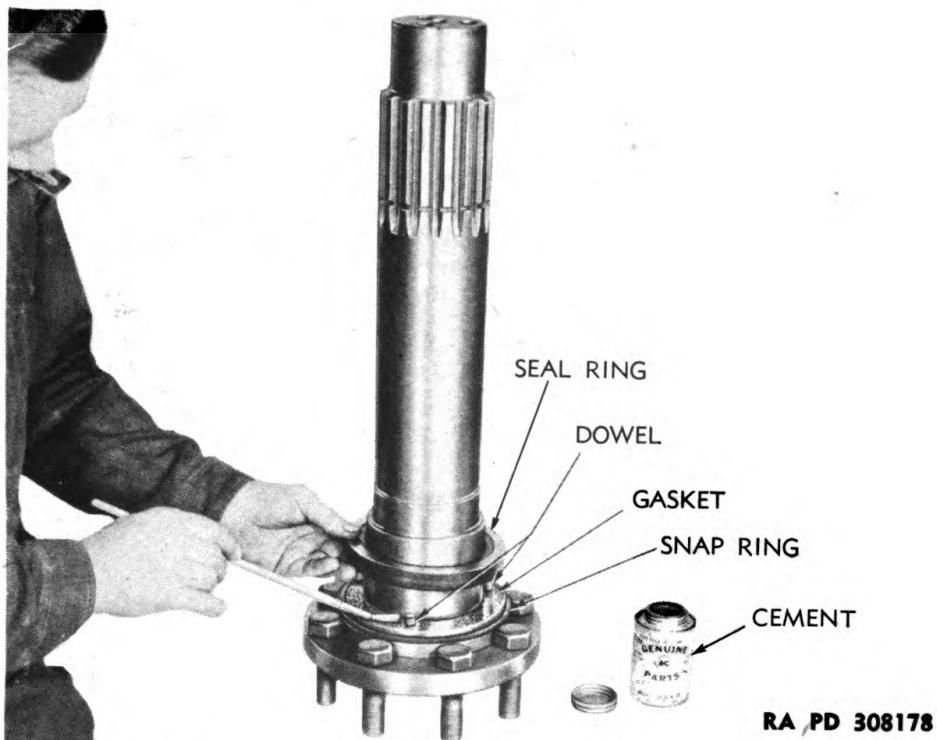


Figure 76 – Installing Outer Seal Ring

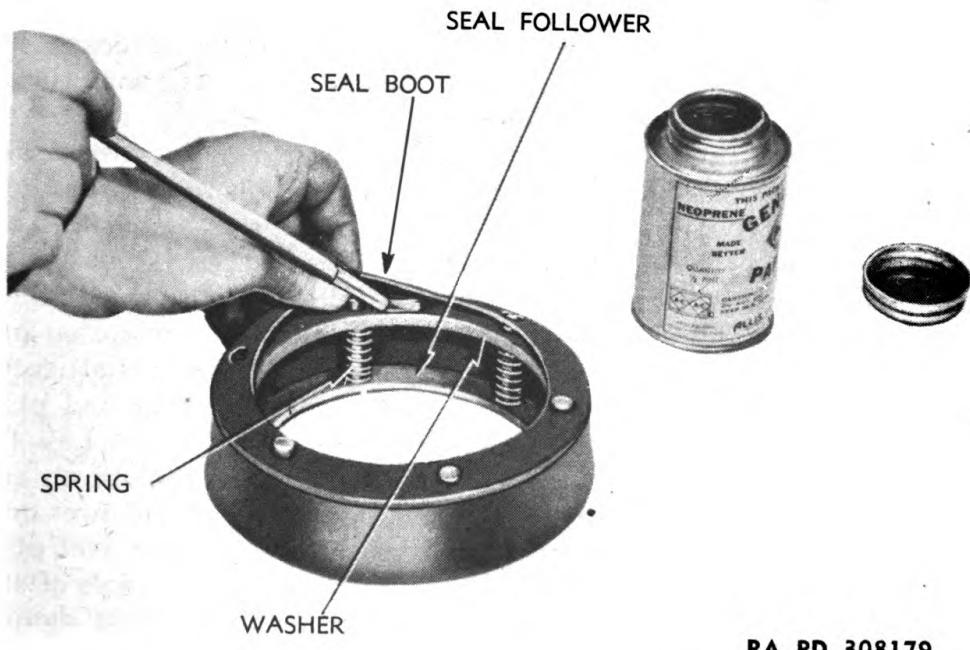
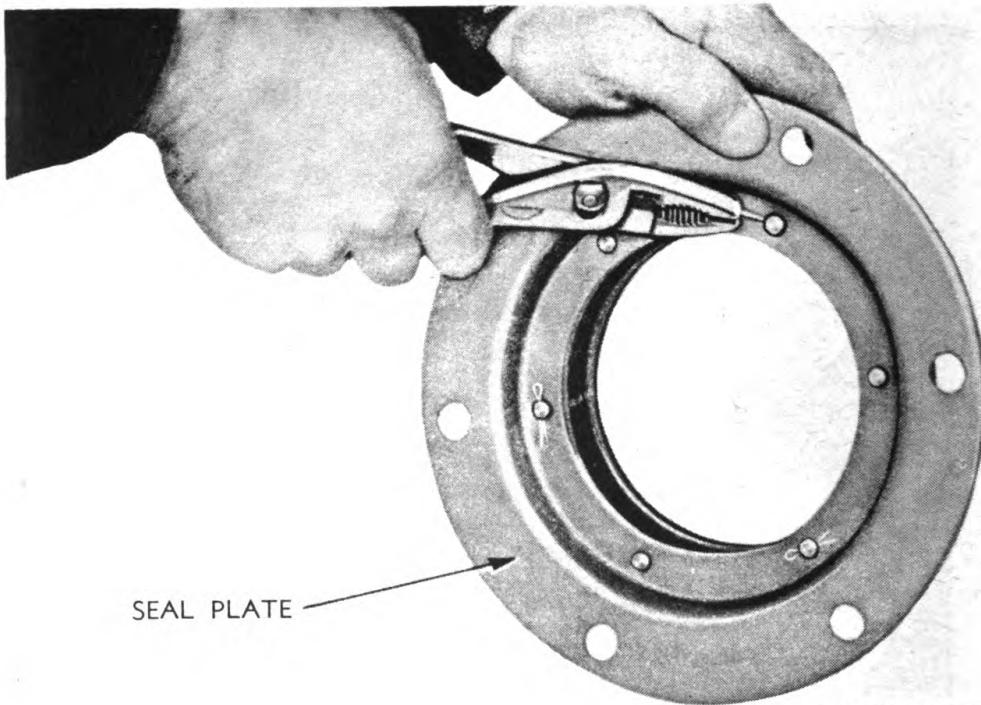


Figure 77 – Cementing Seal Boot to Follower

**EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4
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Figure 78 — Installing Seal Plate on Follower

34. ASSEMBLY AND INSTALLATION.

a. Assemble Sprocket Shaft Assembly. Drive sprocket hub bolts into flange of shaft if they were removed and install snap ring in groove behind bolts. Using nonvulcanizing rubber cement, secure seal gasket to inner side of flange, then coat upper side of gasket with cement (fig. 76) and set outer seal ring on dowels and gasket with sealing surface of ring up. If spring seal follower assembly was disassembled, install springs on the pins in follower, then set washer on pins above springs. Install seal boot on follower and cement inner sides of boot to sides of follower (fig. 77). Place seal plate on projecting pins (fig. 78) and compress springs enough to install cotter pins. Coat opposite outer side of seal boot with cement and place inner seal ring on projecting pins of follower (fig. 79). Lay follower assembly on bench with seal ring up, lay clean cloth on seal ring, and place weight on ring to hold ring tightly against follower until cement dries. Then place seal guard on shaft and lower seal plate with follower and inner seal ring into guard so sealing surfaces of seal rings contact each other. Press outer bearing onto shaft against shoulder. Install snap ring in groove of splines on shaft (fig. 80).

b. Assemble Final Drive Pinion Assembly. Install snap ring in groove in inner splines of pinion if it was removed. Press bearing

FINAL DRIVES

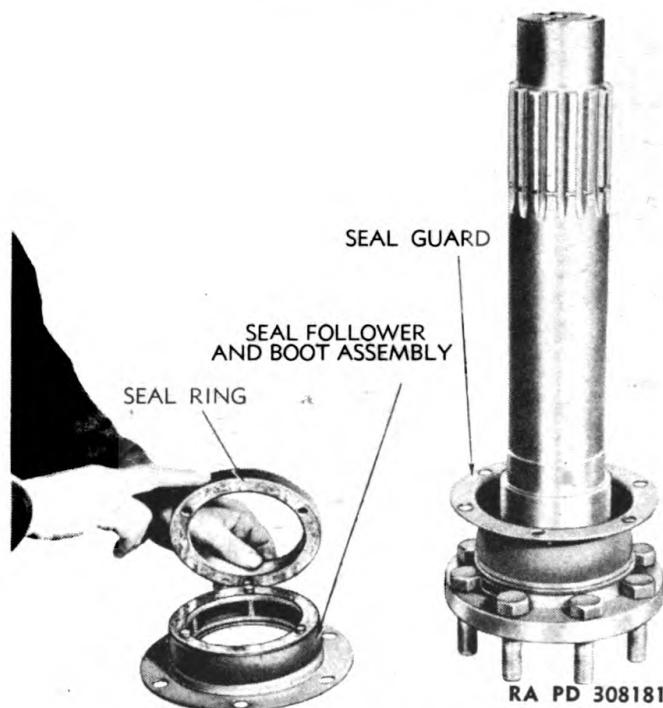


Figure 79 – Installing Inner Seal Ring on Follower

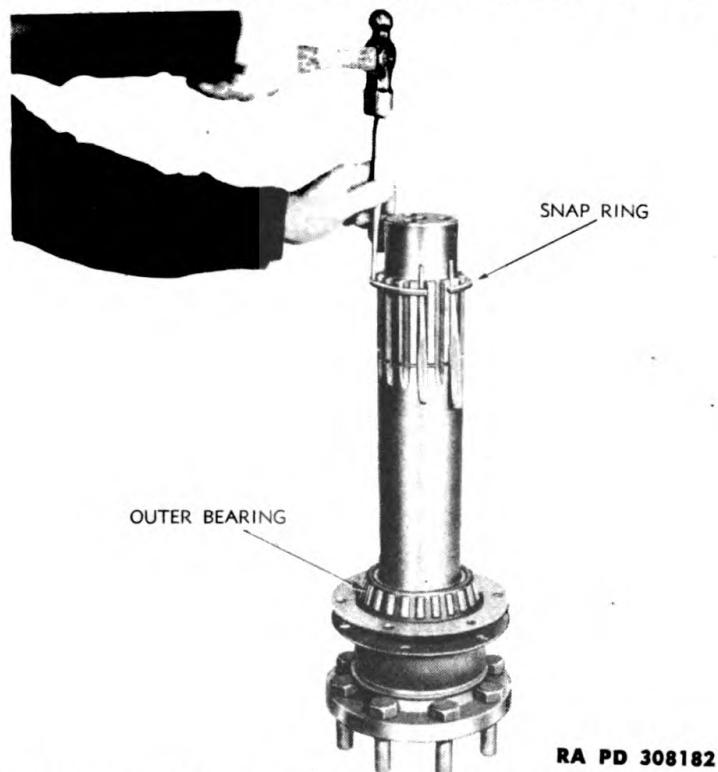


Figure 80 – Installing Snap Ring on Sprocket Shaft

ORDNANCE MAINTENANCE – POWER TRAIN, SUSPENSION, AND EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4

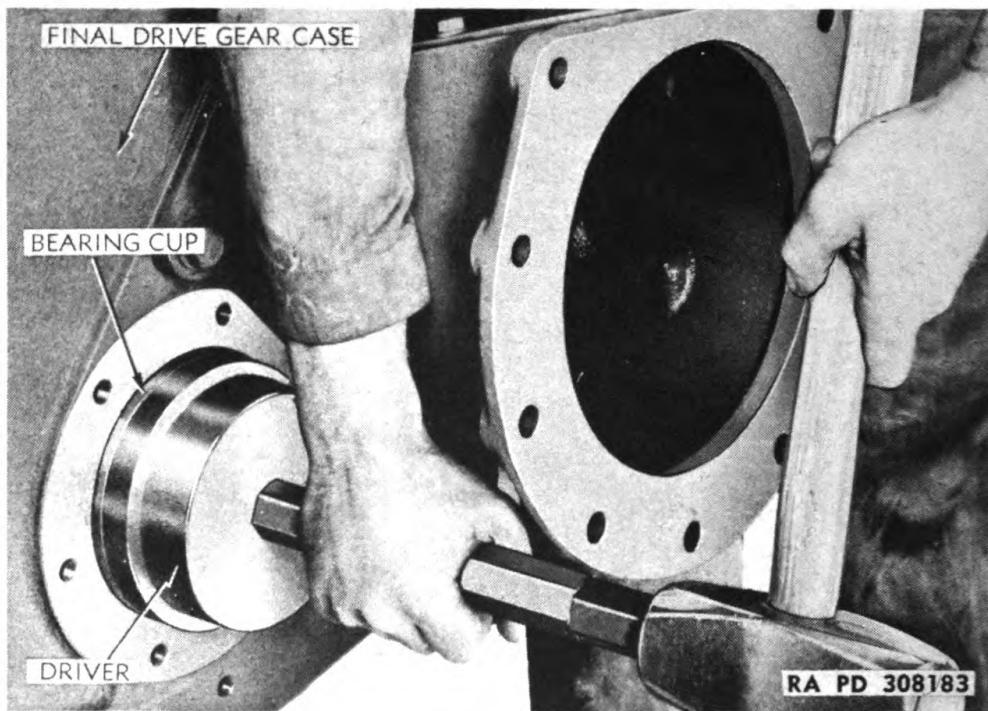


Figure 81 – Installing Sprocket Shaft Outer Bearing Cup, Using Replacer (41-R-2374-875)

cone and roller assemblies onto ends of pinion with smaller diameter facing away from gear teeth.

c. Install Bearing Cups in Gear Case. Drive or press inner pinion bearing cup into inner side of gear case using replacer (41-R-2374-670), and install both sprocket shaft bearing cups in gear case in same manner using replacer (41-R-2374-875). Use above replacers or arbors as shown in figure 81 to install these cups. Leave sprocket shaft bearing cups flush with outer sides of case. The inner pinion bearing cup must be pressed in approximately one-half inch farther.

d. Install Sprocket Shaft and Final Drive Gear. Insert final drive gear into gear case and support gear with center of gear in line with holes for shaft. Cement gasket to seal plate, then insert sprocket shaft through case, turn shaft so splines in end of shaft line up with splines in gear, and push shaft through gear. Install spring washer, bearing spacer, bearing cone, and roller assembly on inner end of shaft, then install bearing adjustment shims totaling 0.075 inch in thickness, bearing washer, and bolt lock at end of shaft with 3 cap screws (fig. 68). Adjust bearings so there is no end play in shaft and shaft can be turned by hand with a very slight drag. This adjustment is made by removing or adding shims under bearing washer. When correct adjustment of bearings has been made and cap screws in end of shaft tightened, bend sides of bolt lock against cap screw heads.

FINAL DRIVES

Install end cap and gasket with 6 cap screws with lock washers. Install 6 cap screws with lock washers through seal guard, seal plate and gasket, and into gear case and tighten securely. Install lower cover with gasket on gear case with 12 cap screws with lock washers. Install and tighten drain and level plugs. Install plug cap screw in outer end of sprocket shaft.

e. Install Final Drive Pinion and Shaft. Slide pinion onto smaller end of pinion shaft, then insert other end of shaft through final drive case and spacer, engaging end of shaft in differential gear (if gear case is installed on tractor). Tap outer pinion bearing cup into place in gear case over bearing rollers. Pinion shaft cap must now be installed temporarily to determine number of shims required for correct bearing adjustment. With cap turned so oil return in cap lines with oil return in case, pull cap up evenly and snugly against outer bearing with six cap screws. Find the maximum total thickness of shims that can be inserted between cap and gear case. Then remove cap and install these shims plus one additional 0.005-inch shim under cap. Tighten cap screws.

f. Install Final Drive Spacer (If Assembly Is Removed From Vehicle). Cement gasket to spacer and attach spacer to gear case with six bolts and five cap screws with lock washers. Install cover and gasket on spacer (if removed) with six cap screws with lock washers. Install bushing and breather in cover.

g. Install Sprocket Hub. With sprockets bolted to hub, install sprocket hub on bolts in sprocket shaft and install and tighten nuts on bolts. Install four puller hole plug cap screws in hub unless already installed.

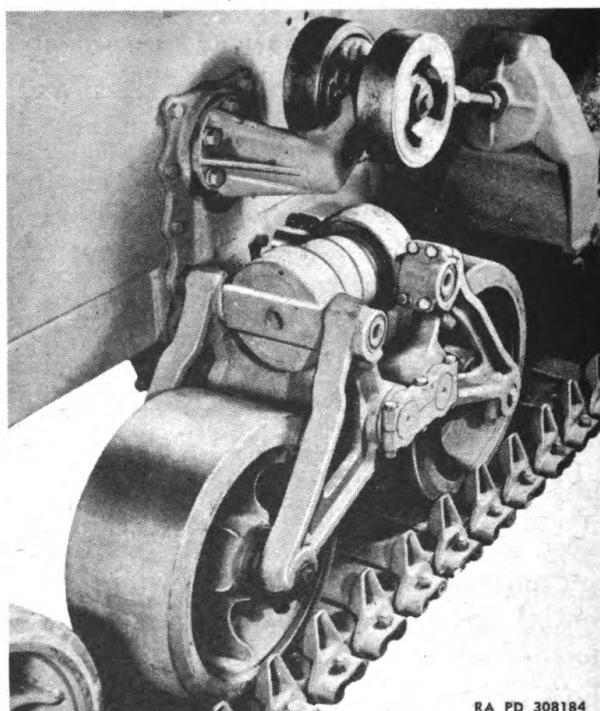
35. INSTALLATION.

a. General. In this paragraph, it is assumed that the final drive assembly was removed from vehicle and the spacer between differential and gear case was left on tractor.

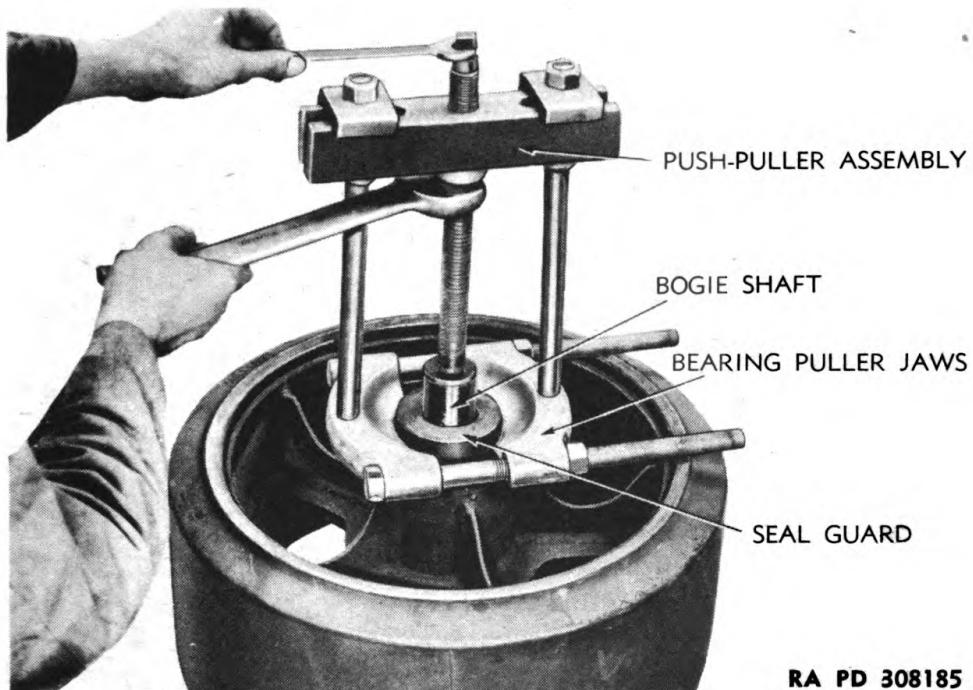
b. Installation. With aid of chain hoist, move assembly into position against tractor. The end of pinion shaft must be inserted through spacer and into differential gear. Install the large cap screw and bolt that attaches bottom and top of gear case to front of hull frame (fig. 10) but do not tighten until the 6 bolts with high nuts and 5 cap screws with lock washers have been installed that attach gear case to spacer (fig. 70). Tighten these bolts and cap screws, then the large bolt and the cap screw. Remove the blocks supporting weight of differential, then install 10 bolts to attach final drive case to bumper support. Install front plate on bumper supports with 22 cap screws and lock washers. Connect and adjust tracks as explained in TM 9-785. Make sure drain plug in gear case is tight and fill gear case with lubricant to level of oil level plug in front of case. Install and tighten level plug.

ORDNANCE MAINTENANCE – POWER TRAIN, SUSPENSION, AND EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4**CHAPTER 6****SUSPENSIONS****Section I****BOGIE ASSEMBLIES****36. DESCRIPTION.**

a. There are two bogie assemblies on each side of tractor, each consisting of two rubber-tired steel wheels held in brackets which oscillate on hinge pins in the bracket that is bolted to hull. A volute spring between the upper parts of the two bogie wheel brackets absorbs road shocks and allows wheels to raise or lower a limited distance when traveling over rough or rocky ground. The bogie wheels rotate on tapered roller bearings and are equipped with positive-type oil seals to prevent leakage of oil or entrance of dirt. Removal and installation of the bogie assemblies is covered in TM 9-785.

**Figure 82 – Bogie Wheel Assembly**

SUSPENSIONS



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**Figure 83 — Removing Bogie Wheel Seal Guards,
Using Puller (41-P-2905-60)**

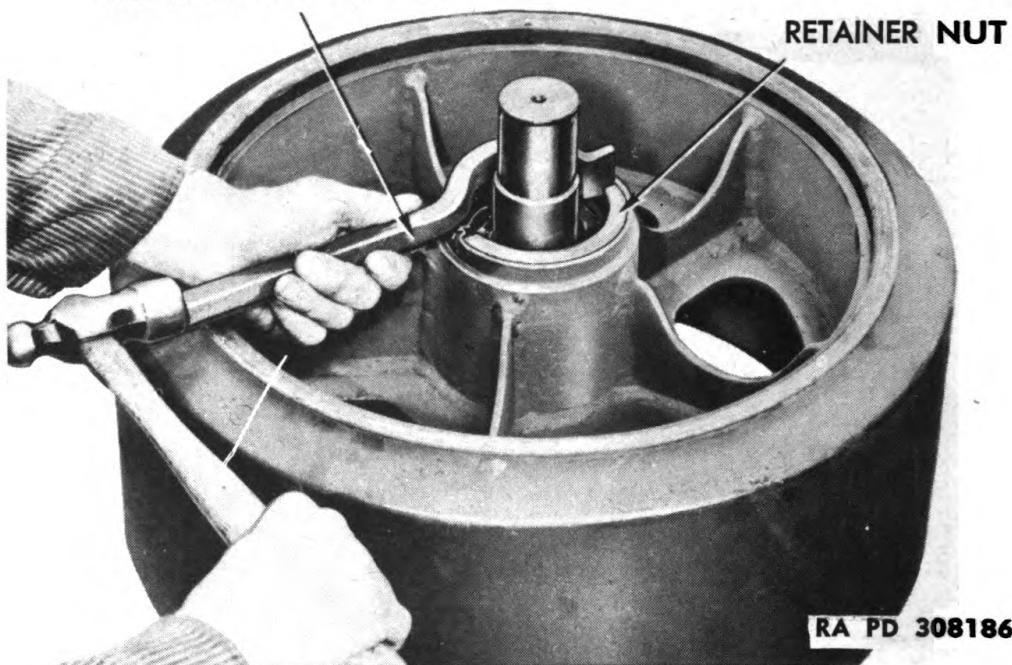
37. DISASSEMBLY OF BOGIE WHEEL.

a. **Remove Seal Guards.** Remove shaft plug and gasket from end of shaft and drain oil from wheel. Using puller (41-P-2905-60) assembled as shown in figure 83, turn forcing screw to pull seal guards off ends of shafts. Remove parts of oil seal assemblies located between seal guards and retainers.

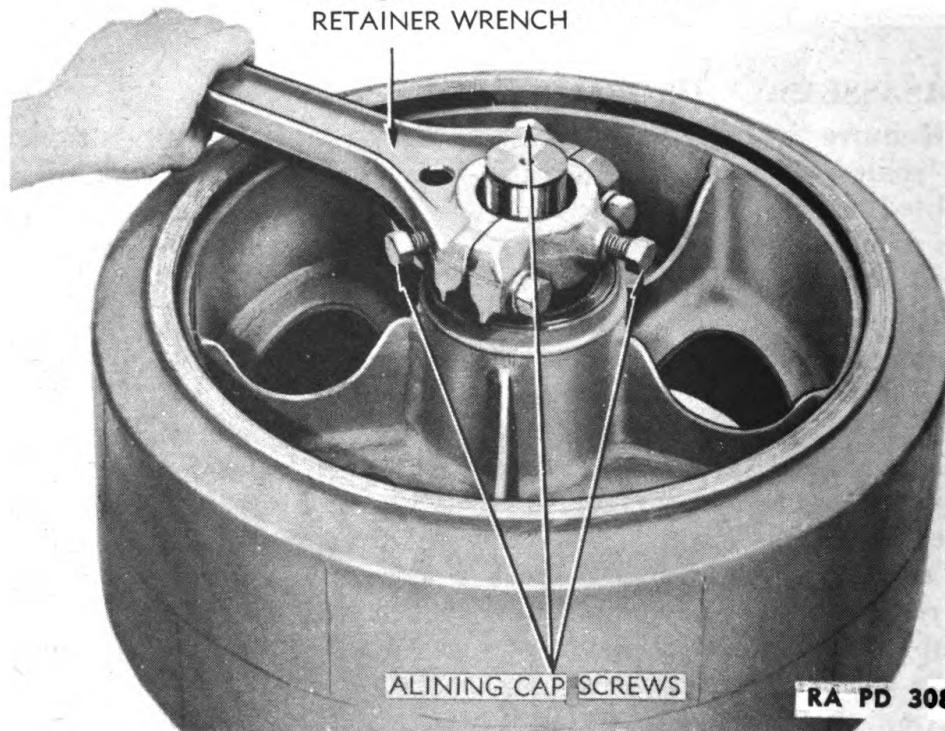
b. **Remove Bearing Retainers.** Straighten locks, holding retainers from turning in wheel, with retainer tool (41-T-3380-30) and hammer as shown in figure 84. Adjust retainer wrench (41-W-3825-130) to fit wrench slots in retainer and turn the three alining cap screws to aline wrench with the shaft (fig. 85). Unscrew retainer from wheel hub and remove shims located behind retainer. Remove retainer and shims from opposite end of wheel hub in like manner. Keep shims and retainer from each side separate, for best results when reassembling. Lay retainers on bench with slotted side down and tap seal rings out of retainers with small punch and hammer. Remove packing ring from seal ring (fig. 86).

c. **Remove Bearings and Shaft.** Using bogie shaft remover (41-R-2378-598) and heavy hammer as shown in figure 87, drive shaft out through wheel. One bearing cup will be driven out of wheel with shaft and both bearings will remain on shaft. Use tool

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RETAINER LOCK TOOL



**Figure 84 — Straightening Retainer Lock,
Using Tool (41-T-3380-30)**



**Figure 85 — Removing Bearing Retainer,
Using Wrench (41-W-3825-130)**

SUSPENSIONS

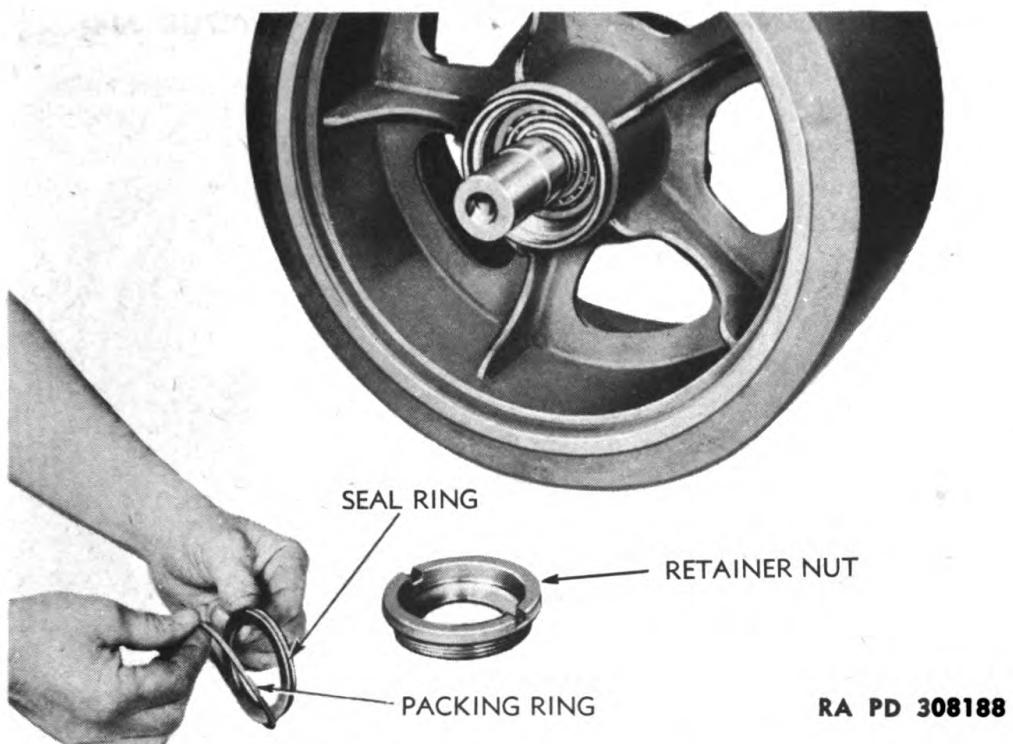
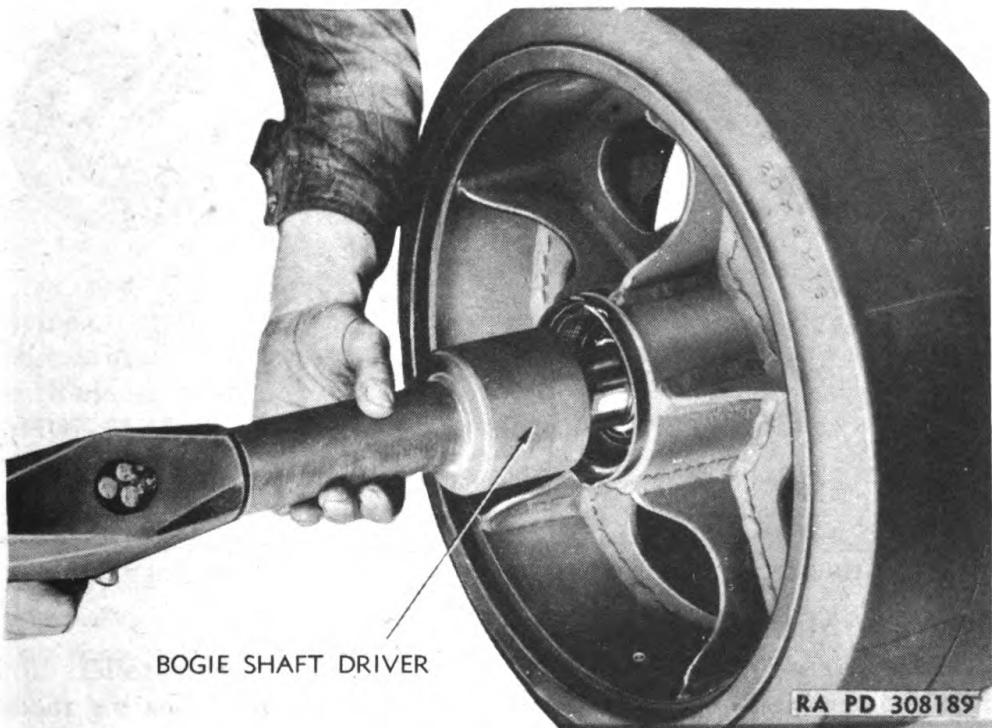
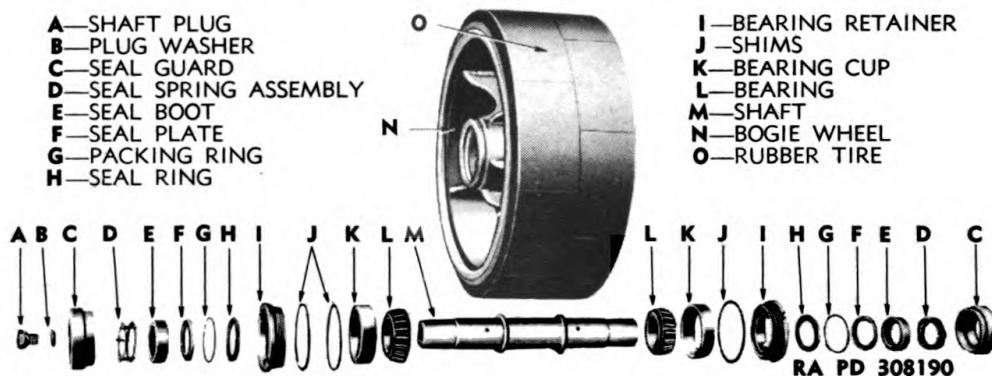
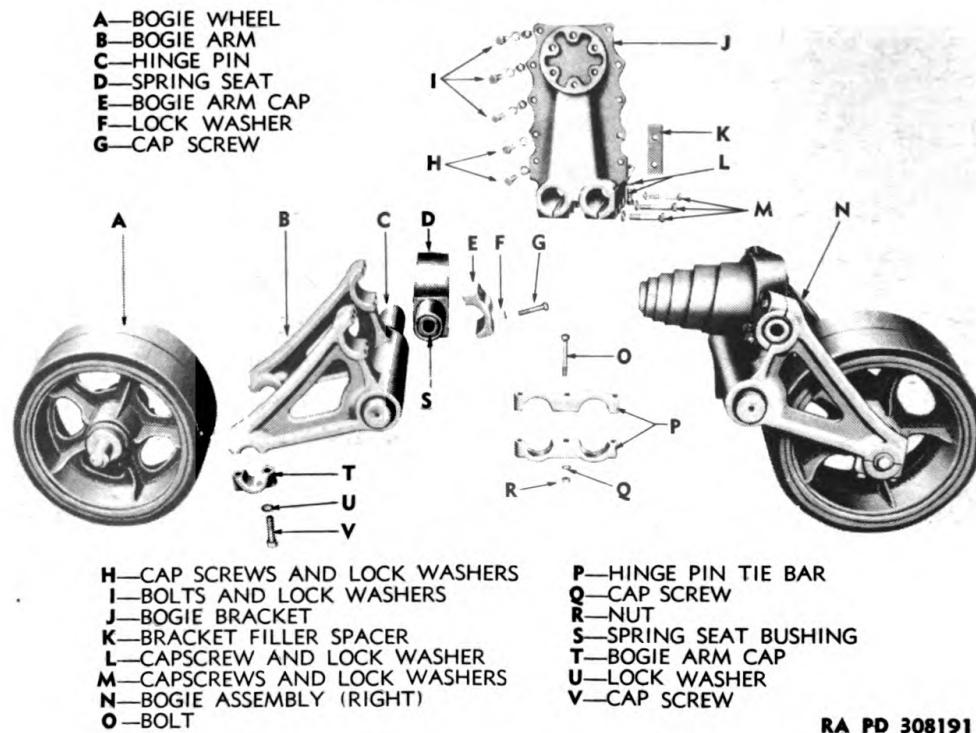


Figure 86 — Removing Packing Ring From Seal Ring



**Figure 87 — Driving Shaft and Bearings From Bogie Wheel,
Using Tool (41-R-2378-598)**

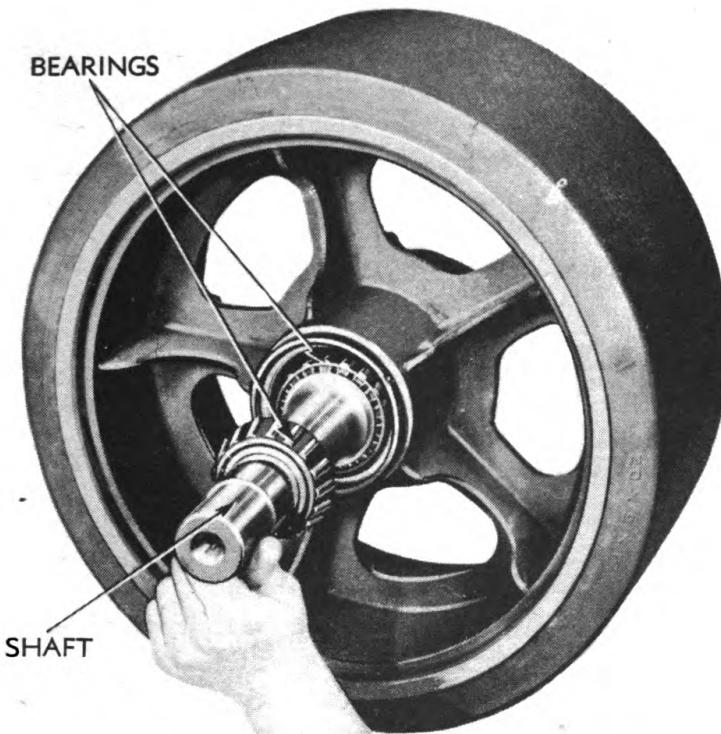
ORDNANCE MAINTENANCE – POWER TRAIN, SUSPENSION, AND EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4

Figure 88 – Bogie Wheel Disassembled

Figure 89 – Bogie Assembly Disassembled

(41-R-2376-295) with tool (41-H-1396-655) and tool (41-H-1396-650) to drive second bearing cup from wheel. Press bearings off shaft.

38. CLEANING AND INSPECTION OF PARTS.

a. **Shafts and Bearings.** Clean and inspect bearing rollers and cups for chipping, roughness, wear, and discoloration. Bearing races, cups, and rollers must have a bright polished surface and be perfectly smooth. Blue or dark colored parts indicate bearings have been overheated and are unfit for further use. If shaft is worn or bent, replace. Blow out oil passages in shaft with compressed air.

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Figure 90 — Installing Bogie Wheel Shaft and Bearings

b. Seal Plates and Seal Ring Assemblies (fig. 90). Clean and inspect seal rings and plates for scoring or roughness. The contacting surfaces of the seal rings and seal plates must be perfectly flat and smooth to insure a perfect seal against entrance of dirt or leakage of oil. Clean grooves in seal rings so that new synthetic rubber packing rings may be installed. Discard worn or damaged parts.

c. Seal Guards and Retainers. Be sure all old cement and particles of synthetic rubber are cleaned off these parts. Discard guards or retainers that are damaged or broken. Clean inside of retainers with emery cloth or flintpaper 2/0 to remove all rust and paint. Remove broken dowels from seal guards, if any, by drilling into broken piece, inserting screw extractor into drilled hole, and turning broken piece out.

d. Seal Boots and Spring Assemblies. The seal boots may be used again when assembling if they are not softened or damaged in any way. Unless noncorrosive oil that is noninjurious to the boots has been used in rollers, the seal boot is apt to have been rendered unfit for further service. Replace seal spring assemblies if pins are loose or broken or assembly twisted.

e. Wheels and Brackets (fig. 89). Repair or replace worn or broken parts of bogie brackets. Replace tires on wheels if unfit for further service. Inspect volute spring, replace if broken or has lost

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tension to point where two or more coils contact spring seats. Replace bogie arm hinge pin if there is evidence of rubber bushing turning in bogie arm. Replacement of these pins requires the use of a hydraulic press and OTC-ED-789 assembly collar and should not be attempted unless this tool is available to guide rubber bushing into bogie arm. Press hinge pin through arm from inside end of arm. The outer end of pin must project $1\frac{1}{4}$ inches out of end of arm after pressure from press is relieved.

39. ASSEMBLY OF BOGIE WHEEL.

a. Install Shaft and Bearings in Wheel. Press bearing cone and roller assemblies onto ends of shaft against shoulders on shaft. Make sure inside of wheel is thoroughly clean, then press or drive one of the bearing cups into hub of wheel until outer face of cup is beyond threads in hub. Use replacer (41-R-2376-295) for driving or pressing cup into wheel. Unless mark is already on shaft, make a mark on plug end of shaft to designate position of oilholes so that when wheel is installed, the shaft can be turned so oilholes next to bearings will be on upper side. Lubricate bearings and insert shaft and bearings into wheel (fig. 90), then drive second bearing cup into hub over bearing into same position as first one installed.

b. Install Bearing Retainers and Shims. Shims 0.0312, 0.010, and 0.007 inch thick are used in installation of retainers to allow for adjustment of bearings. Use the same shims that were removed with retainers if possible, if not, place shims equal in total thickness on both retainers (fig. 91) and screw retainers into hub. Tighten retainers with retainer wrench shown in figure 85 (par. 37 b). *NOTE: Be sure shims do not drop into threads of retainers during installation.* Rotate shaft by hand to test bearing adjustment. Bearings are correctly adjusted if there is no end play in shaft and a slight drag on bearings is felt when shaft is turned. Correct adjustment is made by adding or removing shims back of retainers. Both retainers must be tight when testing adjustment and retainers finally tightened by using hammer on handle of wrench after which bearing adjustment must again be checked. Secure retainers from loosening by bending edge of hub into slots in retainers with tool (41-T-3380-30) (fig. 92).

c. Install Seal Rings in Bearing Retainers. Insert packing ring in groove in seal ring (fig. 86). *CAUTION: Do not roll packing ring into groove, as this is likely to leave a twist or roll in the ring and cause a leak. Ring must lie in groove evenly without being twisted.* Using a block of wood, press seal ring into retainer, with chamfer on inner bore of ring toward threaded end of retainer. It may be necessary to tap block of wood with hammer to properly seat seal plates in retainers. Use clean engine oil on packing ring when installing the seal rings and be careful not to damage, mar, or scratch surface of

SUSPENSIONS

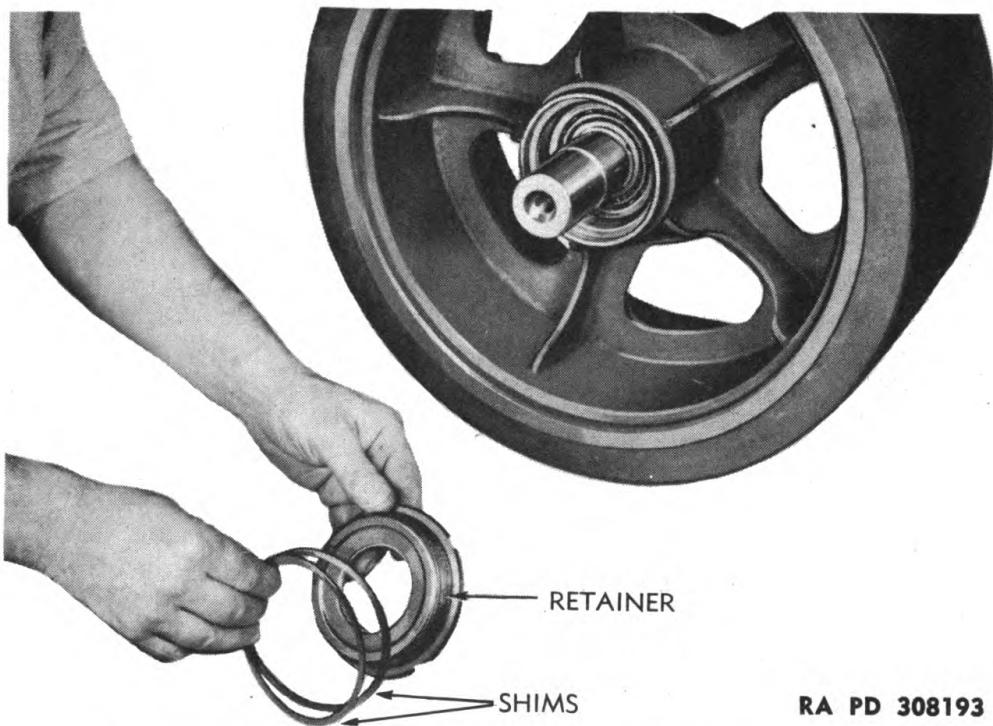


Figure 91 — Installing Shims on Bearing Retainer

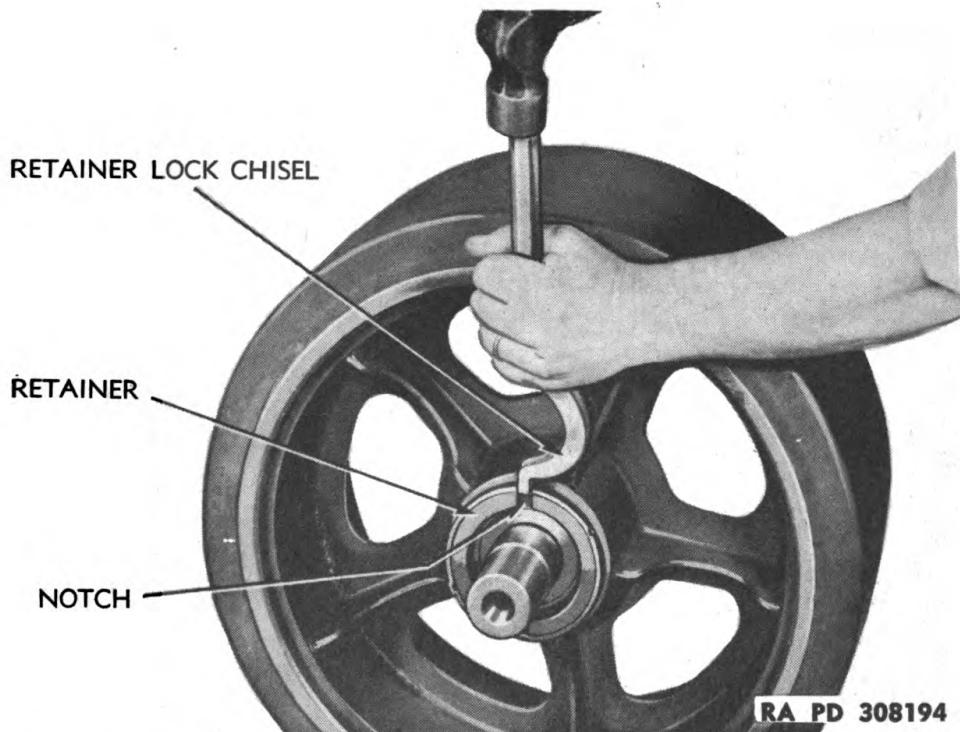


Figure 92 — Locking Bearing Retainer, Using Tool (41-T-3380-30)

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seal ring. Check after installing to determine if it seats properly in retainer and is parallel with the back wall of retainer. There should be a slight springback when seal ring is pressed tightly against the back wall of the retainer. Install second seal ring in second retainer in same manner.

d. Assemble Seal Guards, Seal Springs, and Seal Plates. Install seal boot over seal spring assembly so projecting pins in spring assembly protrude through sides of boot. If boot is out of shape, dip it in boiling water and it will resume its correct shape. Using non-vulcanizing rubber cement, secure inner sides of boot to outer sides of spring assembly in same manner as for trailing idler oil seal boot (fig. 108). Coat outer sides of boot that will contact seal guard and seal plate. Lay seal guard (large end down) on bench and place spring and boot assembly in seal guard so dowels in spring assembly enter holes in inner side of seal guard. Lay seal plate on dowels in top side of spring assembly, then cover polished surface with clean cloth, place weight on seal plate, and allow cement to dry for at least one hour. Repeat operations for second assembly.

e. Install Seal Guards. Place wheel in press, lubricate sealing surfaces of seal plates and seal rings with light engine oil, and press seal guards onto ends of shafts so outer faces of guards are even with shoulders on shafts. Fill wheel with oil with lubricator furnished with tractor and install shaft plug and gasket.

Section II**TRACK SUPPORT ROLLERS****40. DESCRIPTION.**

a. Two track support rollers on each side of tractor, support the upper side of the track as it passes from the trailing idler to the drive sprocket. Two different type rollers may be found on the tractor (figs. 96 and 99). Tractors with serial numbers M4-1 to M4-300 were equipped with rollers with double wheels. Tractors with serial numbers M4-301 and above were equipped with the second-type single wheel rollers. Rawhide oil seals were used in the first-type rollers, the second- or later-type rollers are equipped with positive oil seals similar to those in the bogie wheels and trailing idlers.

b. The procedure for the removal and installation of the track support rollers is given in TM 9-785.

SUSPENSIONS

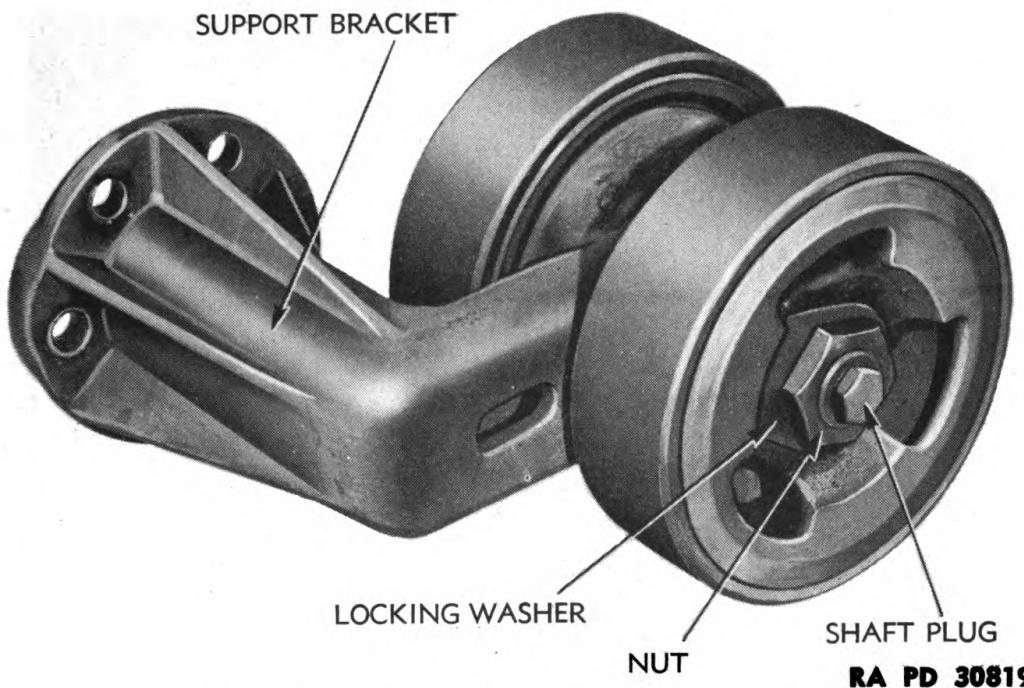


Figure 93 – Track Support Roller (First Type)

41. DISASSEMBLY.

a. Disassembly of First-type (Double Wheel) Roller.

(1) REMOVE ROLLERS AND BEARING RETAINER. Remove shaft plug and copper gasket from end of shaft, set roller on end, and drain oil from roller. Install plug and gasket after oil is drained. Straighten locking washer at each end of support roller shaft and remove nuts from ends of shaft. Pull both rollers off shaft with a gear puller as shown in fig. 94. Remove the six cap screws from each bearing retainer, and remove retainer and shims back of retainers. *NOTE: Tie each group of shims to the retainer that was removed with them for assembly purposes.*

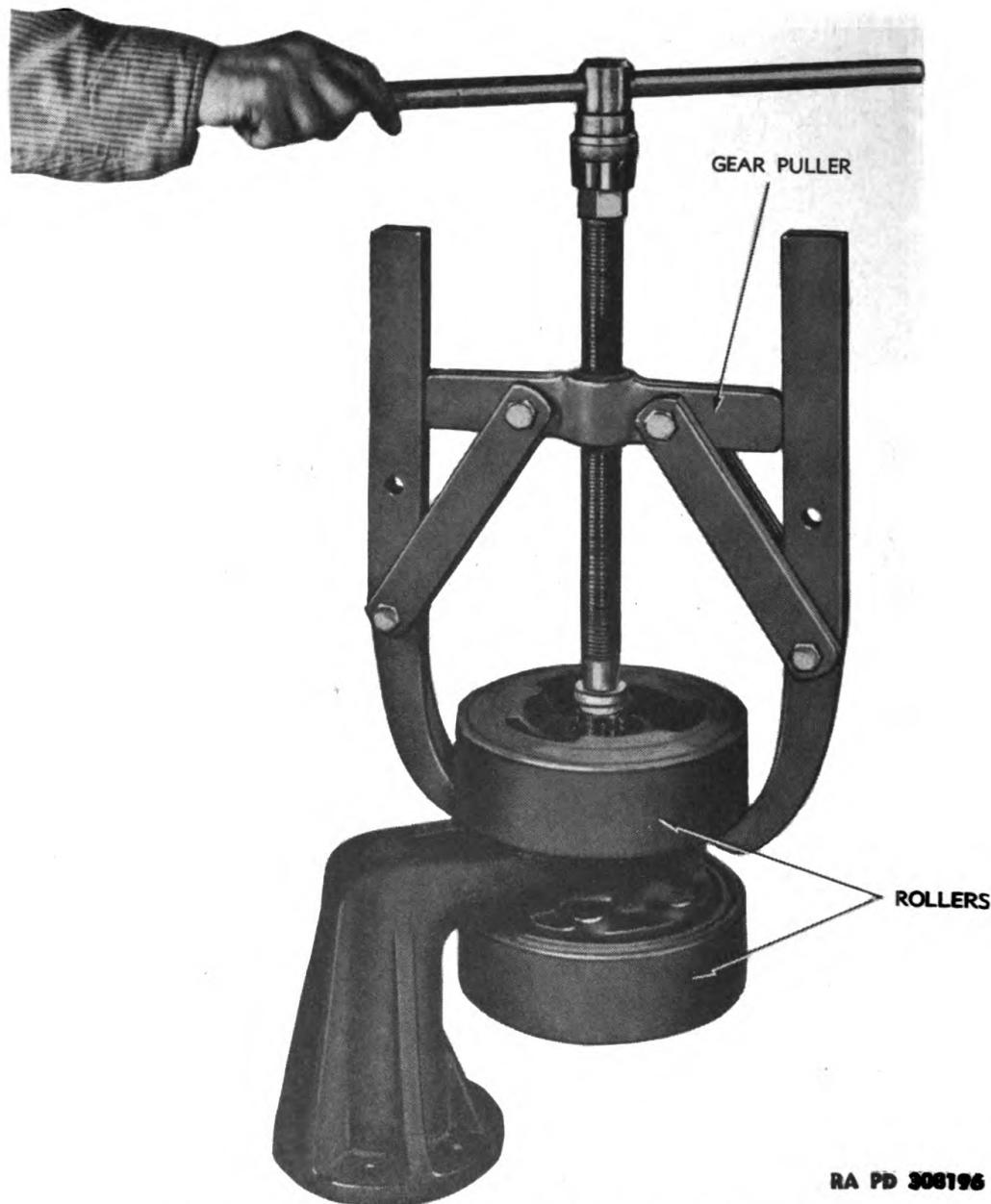
(2) REMOVE SHAFT AND BEARINGS. Drive shaft out of support bracket with soft hammer. One bearing cup will be removed at this time. Bearing cone and roller assemblies will remain on shaft. Drive second bearing cup from bracket, using replacer (41-R-2376-295), handle (41-H-1396-655), and handle (41-H-1396-650) shown in figures 95 and 97. Press bearings from shaft with arbor press.

(3) REMOVE OIL SEALS FROM BEARING RETAINERS. Do not remove these oil seals unless they are to be replaced as they will be damaged in removal. Use punch and hammer to drive them from retainers if they are to be removed.

b. Disassembly of Second-type (Single Wheel) Roller (fig. 99).

(1) REMOVE ROLLER FROM BRACKET. Remove drain plug and drain oil from assembly. Remove the eight cap screws from outer

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**Figure 94 — Removing Rollers From Shaft,
Using Puller (41-P-2910)**

bearing retainer and remove retainer. Straighten lock washer, then remove bearing adjusting bolt with lock washer, heavy washer, and shims from bracket shaft. Remove the eight cap screws from inner bearing retainer. Pull or press roller from bracket. Outer bearing cone and roller assembly will be removed in pulling roller from shaft; both bearing cups will remain in roller. Drive or press these cups from roller.

SUSPENSIONS



Figure 95 — Removing Roller Shaft Bearing Cup

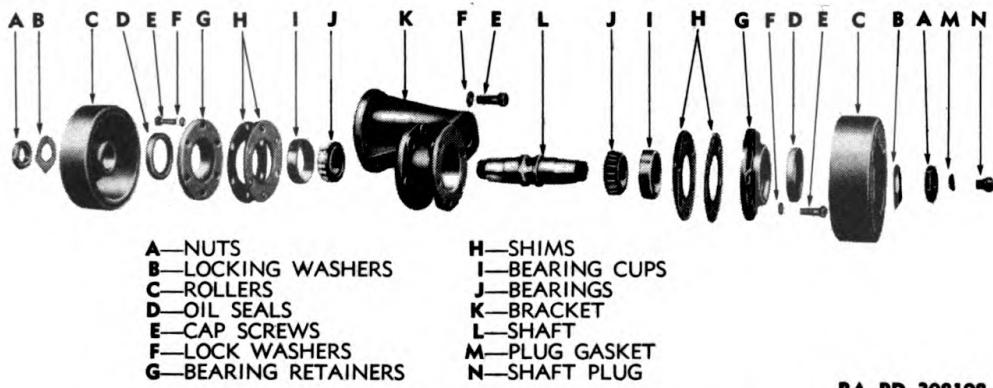


Figure 96 — Track Support Roller (First Type) Disassembled

(2) REMOVE INNER BEARING, RETAINER, AND OIL SEAL. Assemble puller (41-P-2905-60) in a manner similar to that shown in figure 70, forcing edges of jaws between inner bearing race and shoulder on shaft to pull inner bearing from shaft. Use adapter between end of forcing screw and end of shaft. After bearing is removed, slide inner bearing retainer and oil seal parts off shaft.

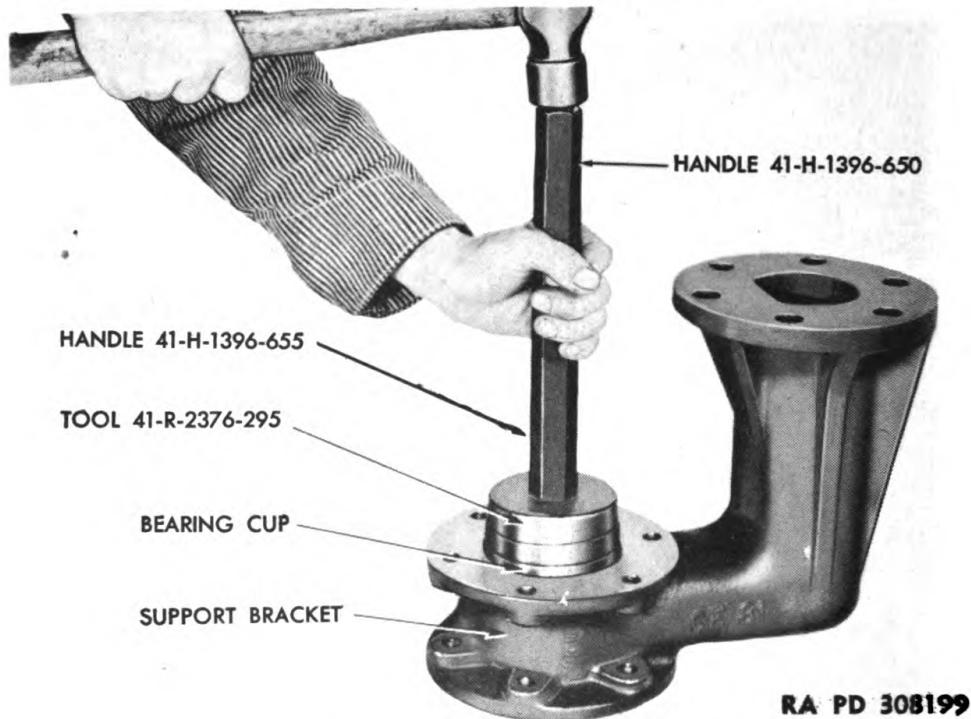
42. CLEANING AND INSPECTION OF PARTS.

a. Wash all parts thoroughly in dry-cleaning solvent. Discard broken parts.

b. Support Bracket. Check bracket to make sure it has not been twisted or bent. Small cracks, unless appearing in bearing compartment, may be brazed or welded. Replace broken or missing dowels in shaft or inner bearing retainer of second-type roller.

c. Roller Shaft. Make sure shaft is smooth and straight and threads on ends of shaft and in shaft nuts are not damaged. Clean out oil passages in shaft and blow out with compressed air. Check to see that bearings fit snugly on shaft.

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Figure 97 — Installing Inner Bearing Cup

d. Bearings. Clean bearings thoroughly and blow dry with compressed air. Inspect for rough or pitted places in rollers or races. Rollers and races must be perfectly smooth and surfaces have a polished finish. Discard discolored bearings as discoloration indicates bearings have been overheated in operation and are unfit for further use. After inspection, oil bearings with light engine oil and wrap in paper to protect them from dust.

e. Oil Seals. Discard rawhide oil seals in first-type roller if worn or damaged. The life of the roller depends largely on effective sealing to prevent loss of lubricant. Inspect seal rings in second-type roller. These rings must be perfectly smooth and polished to effect a good seal. Replace rings if scored, worn, or nicked. Replace seal spring assembly if damaged in any way. Replace rubber seal boot if damaged or deteriorated.

43. ASSEMBLY.

a. Assembly of First-type (Double Wheel) Roller.

(1) **INSTALL BEARING CONE AND ROLLER ASSEMBLIES ON SHAFT.** Using arbor press, install bearing cone and roller assemblies onto shaft against shoulders with rollers facing ends of shaft.

(2) **INSTALL SHAFT AND BEARING IN SUPPORT BRACKET.** Using arbor press or replacer (41-R-2376-295) with handles as shown in

SUSPENSIONS

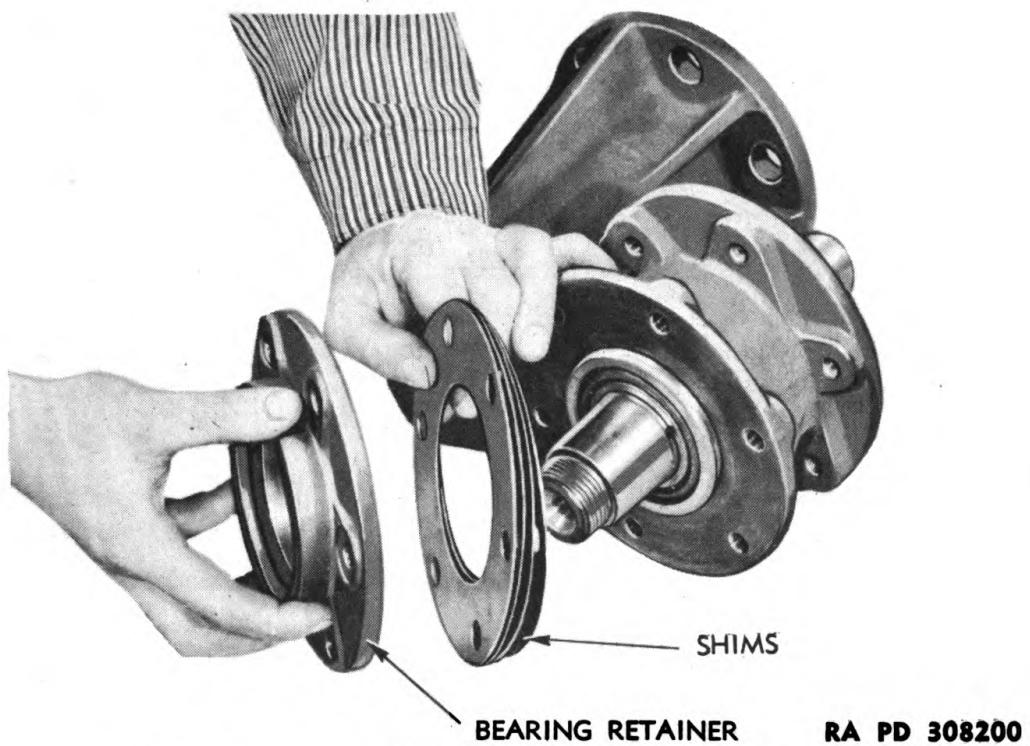


Figure 98 — Installing Shims and Bearing Retainers

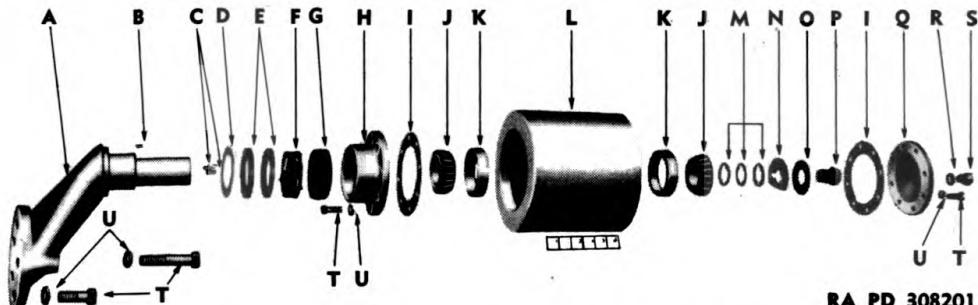
figure 97, install inner bearing cup in support bracket, leaving cup projecting about $\frac{3}{16}$ inch out of bracket. Insert shaft, with bearings installed, through bracket with end of shaft with tapped hole to outer side of bracket. Drive or press outer bearing cup into outer side of bracket over outer bearing.

(3) **INSTALL BEARING RETAINERS.** Press oil seals into retainers with lips of seals facing inner side of retainer, then install bearing retainers on sides of bracket with six cap screws with lock washers in each. Install shims totaling approximately 0.060 inch in thickness under each retainer (fig. 98). Tighten cap screws securely, then test bearing adjustment. Adjust bearings so there is no end play in shaft, yet shaft will roll quite freely when turned by hand. This is done by removing the retainers and adding shims behind retainers if bearings are too tight or removing shims if bearings are too loose. Always add or remove an equal amount of shims from both sides to insure centering of roller in support. Always test bearing adjustment with retainer cap screws drawn tight.

(4) **INSTALL ROLLERS ON ENDS OF SHAFT.** Tap or press rollers onto ends of shafts with open sides of rollers toward bracket (fig. 93). Place lock washers on ends of shaft with flat edge of washer against one of the spokes of the roller, then install nuts and tighten securely. Bend a section of round part of washer over against one side of nut

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A—BRACKET	H—BEARING RETAINER	O—LOCK WASHER
B—DOWEL	I—RETAINER GASKETS	P—BEARING ADJUSTING BOLT
C—DOWELS	J—BEARINGS	Q—BEARING RETAINER
D—SEAL GASKET	K—BEARING CUPS	R—PLUG GASKET
E—SEAL RINGS	L—ROLLER	S—SHAFT PLUG
F—SEAL SPRING ASSEMBLY	M—SHIMS	T—CAP SCREWS
G—SEAL BOOT	N—ADJUSTING BOLT WASHER	U—LOCK WASHERS



RA PD 308201

Figure 99 — Track Support Roller (Second Type) Disassembled

to lock nut. Fill roller with lubricant with lubricator furnished with tractor and install shaft plug with copper gasket.

b. Assembly of Second-type (Single Wheel) Roller (fig. 99).
(1) INSTALL OIL SEAL ASSEMBLY AND INNER BEARING RETAINER.

Set bracket on bench with shaft up. Install dowels in holes in lower shoulder on shaft (if removed) and install seal ring gasket, then one seal ring against shoulder with polished surface towards end of shaft and holes in ring engaging dowels. Install rubber seal boot over seal spring assembly so pins project through holes in sides of boot. Using nonvulcanizing rubber cement, cement inner sides of boot to sides of spring in a manner similar to that shown in figure 109. Set inner bearing retainer on bench with flange down, coat outer sides of boot with cement and insert spring and boot assembly into inner bore in inner bearing retainer so that pins in side of spring enter holes in retainer. Set second seal ring on upper side of spring assembly. Lay clean cloth on polished surface of seal ring and place weight on assembly to hold parts tightly together. Allow at least one hour for cement to dry. Then wipe off contacting surfaces of seal rings with clean cloth, lubricate surfaces with light engine oil, and slide inner retainer onto shaft so seal rings contact one another. Cement gasket to inner side of retainer.

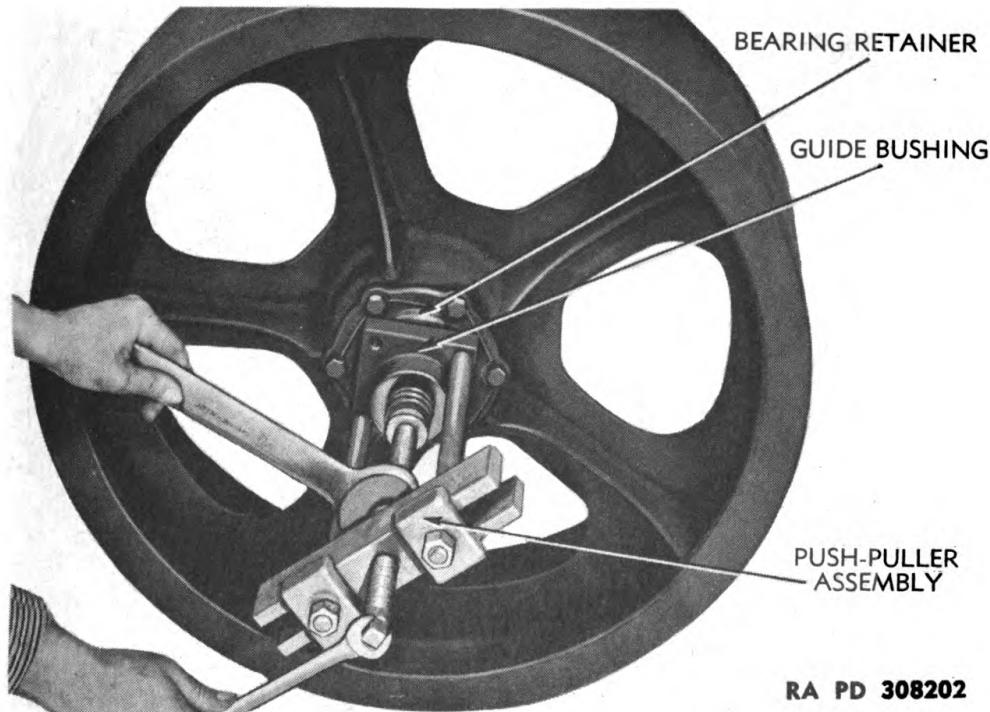
(2) INSTALL ROLLER AND BEARINGS. Press bearing cups into hubs of roller wheel with beveled surfaces facing outward. Drive inner bearing cone and roller assembly against shoulder on shaft, using brass punch and hammer. Install wheel on shaft, then driver outer bearing onto shaft. Place shims totaling approximately 0.060 inch in thickness on end of shaft over dowels, the adjusting bolt washer, and lock washer, then install and tighten bearing adjusting

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bolt in end of shaft. Install eight cap screws with lock washers in inner bearing retainer and wheel. Test bearing adjustment by turning wheel. Add or remove shims to adjust bearings so there is no end play of wheel and wheel will turn fairly easily when rolled by hand. After bearings are correctly adjusted and adjusting bolt tightened, bend sides of lock washer against side of bolt head. Cement gasket to outer bearing retainer and install retainer on wheel. Fill wheel with lubricant using lubricator furnished with tractor, and install shaft plug with copper washer.

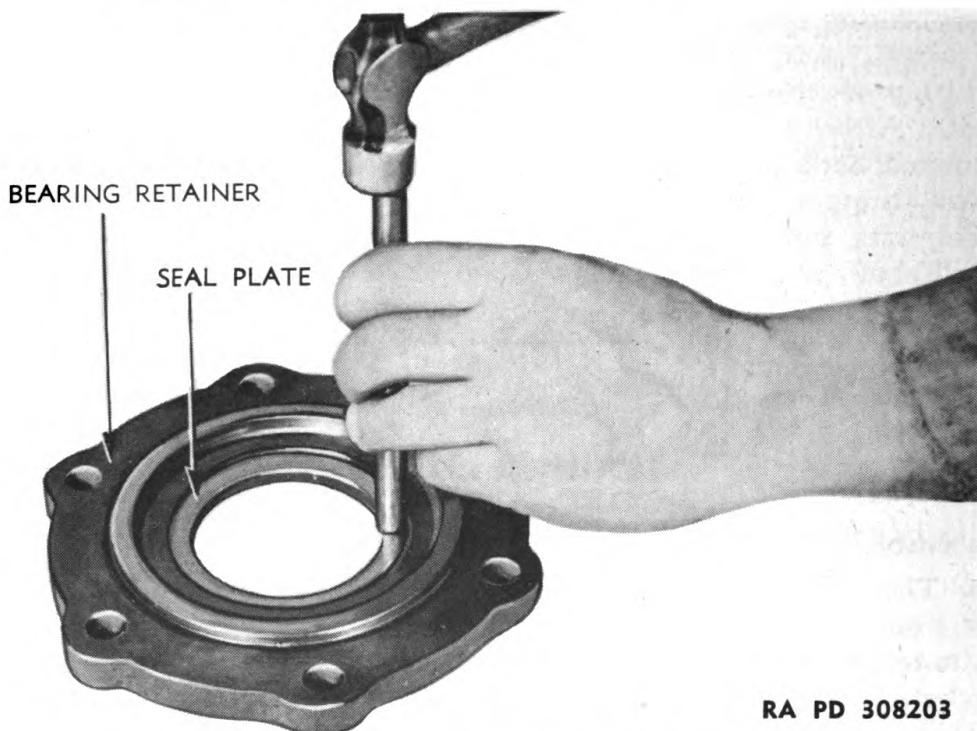
Section III**TRAILING IDLERS****44. DESCRIPTION.**

a. The trailing idlers are large steel wheels similar in construction to the bogie wheels. They are mounted in yokes connected by hinge shafts to the idler brackets on hull. Volute springs in idler support brackets provide tension for the tracks and also allow idlers and yokes to raise or lower when traveling over rough or rocky terrain.



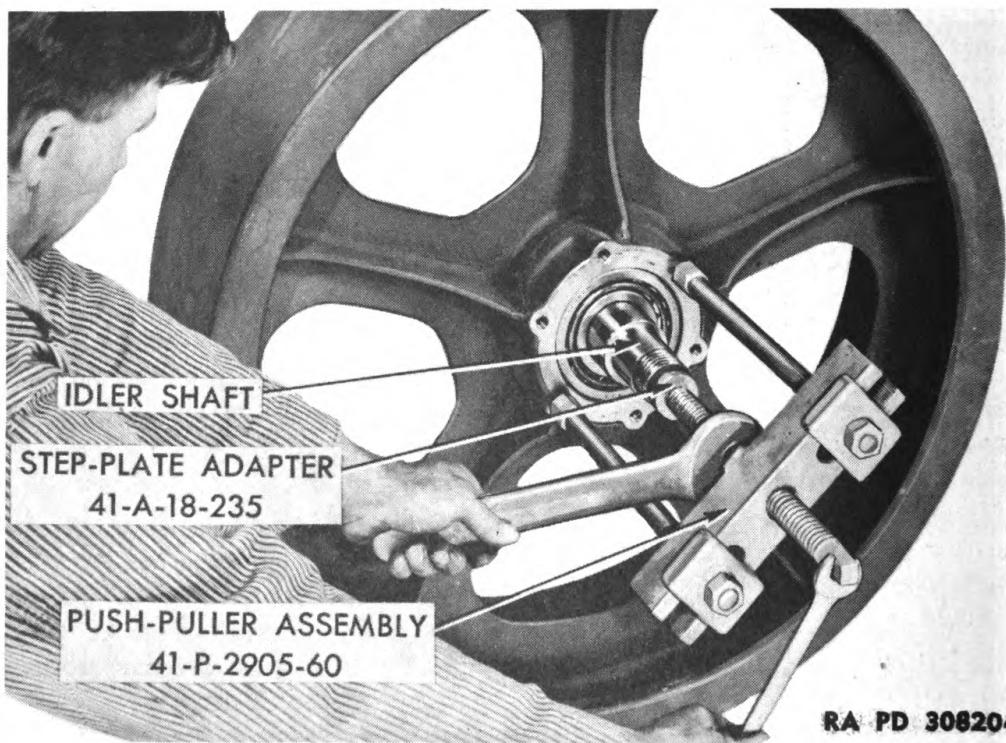
**Figure 100 — Removing Guide Bushings From Idler Shaft,
Using Puller (41-P-2905-60)**

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RA PD 308203

Figure 101 – Removing Seal Plate From Retainer



RA PD 308204

Figure 102 – Pushing Shaft and Bearings From Idler Wheel

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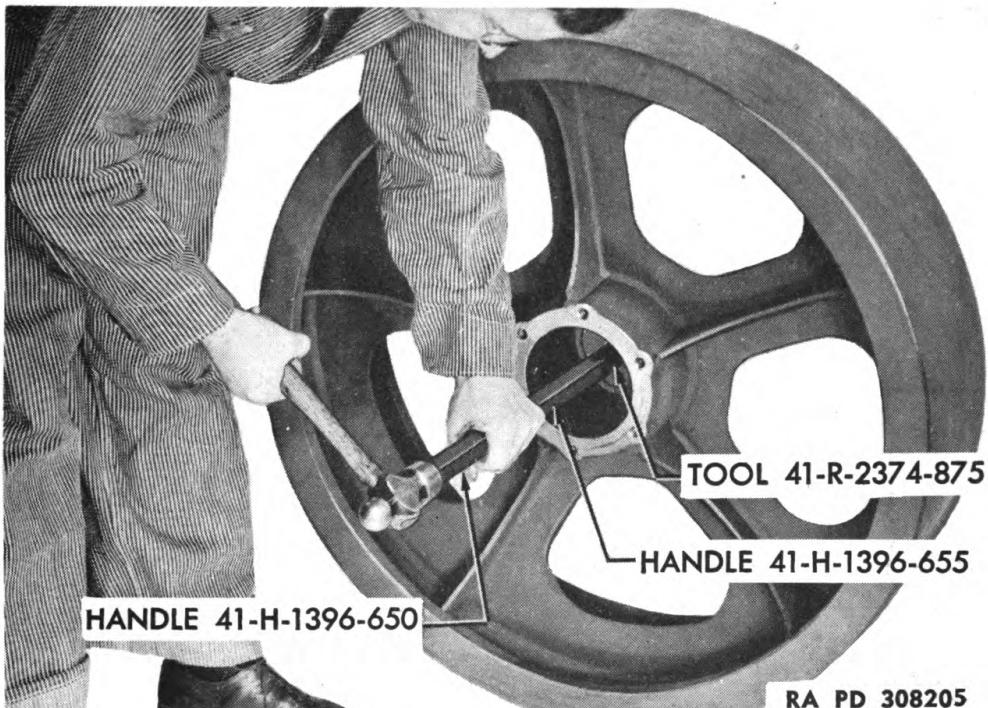


Figure 103 – Removing Second Idler Shaft Bearing Cup

A—SHAFT PLUG
 B—PLUG GASKET
 C—GUIDE BUSHINGS
 D—SEAL SPRINGS
 E—SEAL BOOTS
 F—SEAL RINGS
 G—PACKING RINGS
 H—SEAL PLATES

I—CAP SCREW
 J—BEARING RETAINERS
 K—SHIMS
 L—BEARING CUPS
 M—BEARINGS
 N—SHAFT
 O—IDLER WHEEL
 P—LOCK WIRE

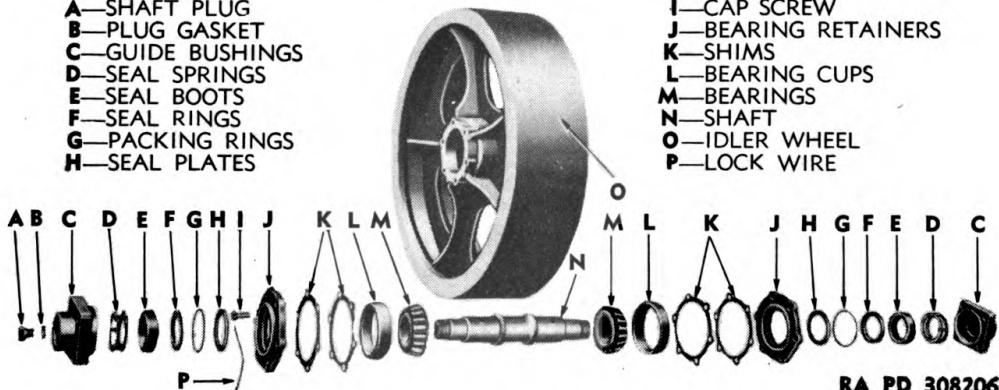


Figure 104 – Trailing Idler Wheel Disassembled

Serrations in the idler yokes and adjusting brackets provide for adjustment of track tension.

45. DISASSEMBLY OF IDLER WHEEL.

a. **Remove Guide Bushings From Idler Shaft.** Remove plug from end of shaft and lay wheel on side to drain oil from wheel. Use puller (41-P-2905-60) to pull guide bushings off ends of shaft. Screw the ends of puller legs into tapped holes in bushing as shown in fig. 100 and use an adapter between end of forcing screw and end of shaft. Turn forcing screw to pull the bushings. Oil seal springs, boot assemblies, and seal rings will come off with bushings.

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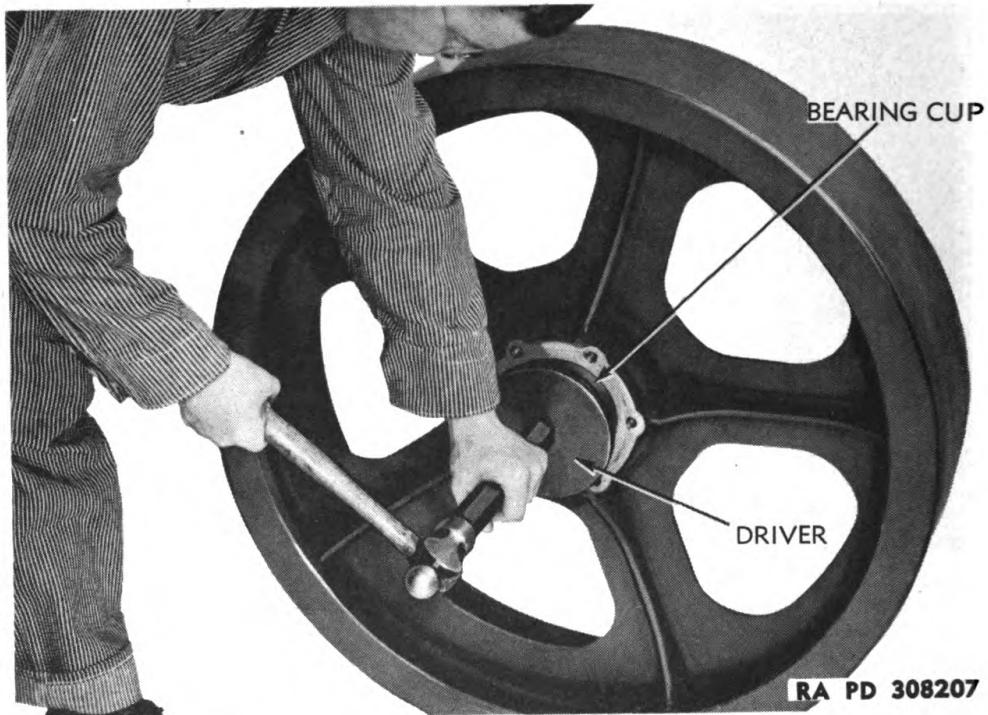


Figure 105 – Installing Idler Shaft Bearing Cup

b. Remove Idler Shaft and Bearings. Cut and remove lock wires from heads of retainer cap screws and remove the six cap screws from each retainer. Remove the retainers and shims back of retainers (fig. 107). Tap seal plates out of retainers with small punch and hammer. Tie shims to the retainer with which they were removed. Install adapters (41-A-18-235) in two of the tapped holes in hub of wheel, assemble puller in same manner as for removing guide bushings from shaft (fig. 102), and push shaft and bearings out of wheel. One bearing cup will remain in wheel. Use remover (41-R-2374-875) with two handles (41-H-1396-655) and handle (41-H-1396-650) to remove this bearing cup (fig. 103). Press bearing cone and roller assemblies off shaft.

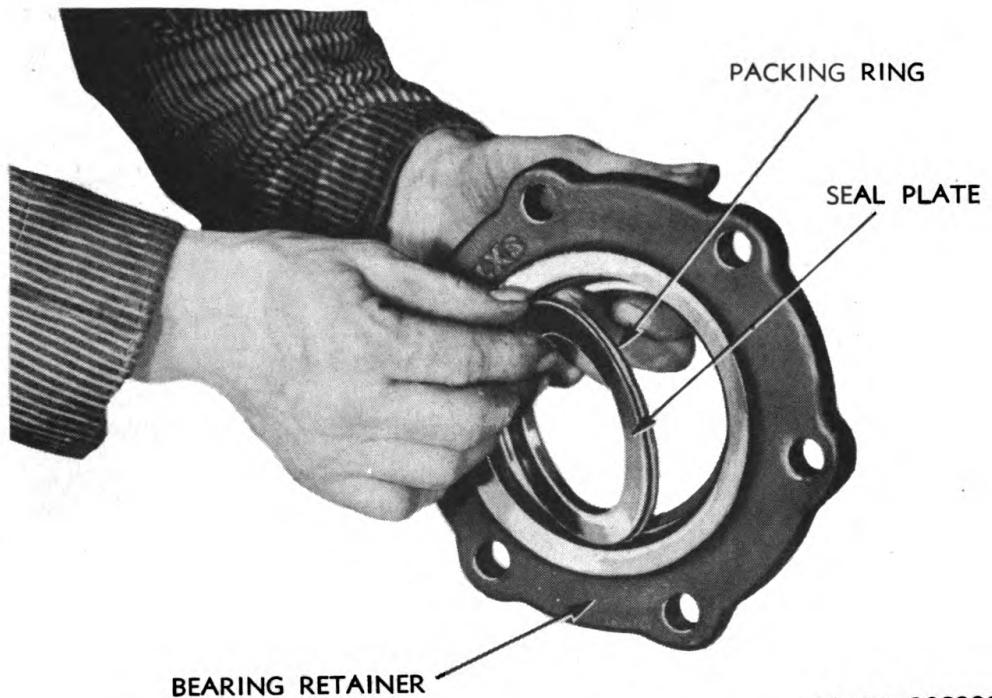
46. CLEANING AND INSPECTION OF PARTS.

a. Refer to paragraph 38 which outlines the inspection of parts for the bogie wheels. Since the parts in idler are similar to those in the bogie wheel, the same inspection can be followed.

47. ASSEMBLY OF IDLER WHEEL.

a. Install Idler Shaft and Bearings. Press two bearing cone and roller assemblies onto shaft against shoulders with rollers facing ends of shaft. Unless already marked, make a mark on tapped end of shaft to indicate position of oilholes in shaft at outer sides of bearings. These marks will be used later when guide bushings are in-

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RA PD 308208

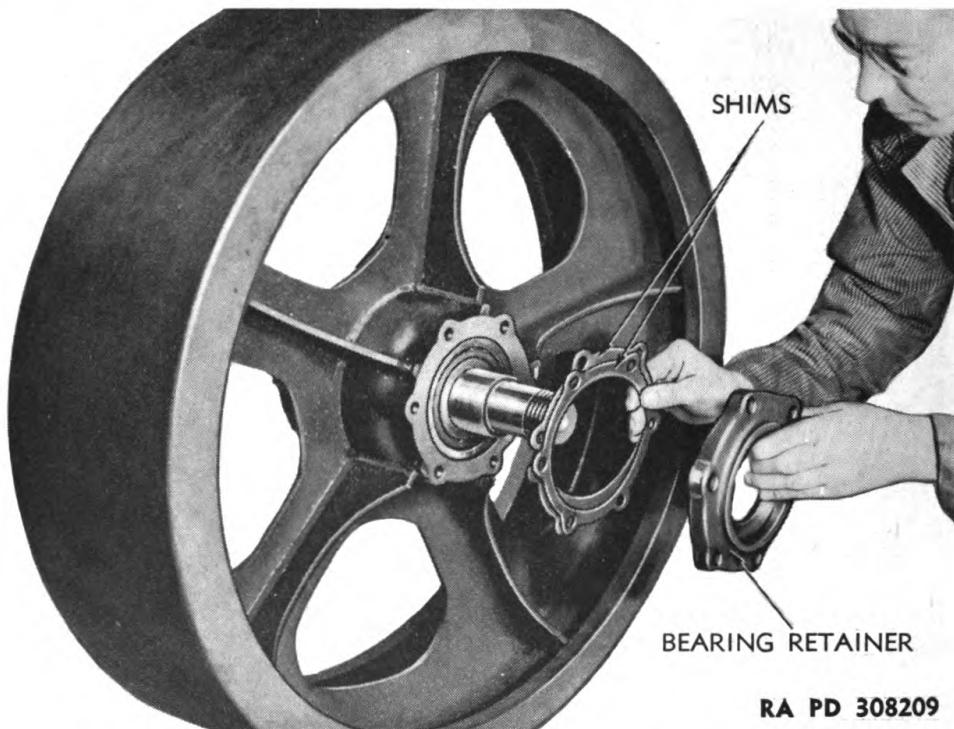
Figure 106 — Installing Oil Seal Plate in Bearing Retainer

stalled to insure that these holes will be on upper side of shaft when wheel is installed in tractor. Drive a bearing cup into hub of idler wheel as shown in figure 105 with same tool as used to remove cup (par. 45 b). Insert shaft and bearings into wheel, then install second bearing cup in hub over bearing.

b. Install Oil Seal Plates in Bearing Retainers. Install packing ring in groove of seal plate (fig. 106). **CAUTION: Do not roll packing ring into groove as this is likely to leave a twist or roll in the ring and cause a leak. Ring must lie evenly in groove with no twist.** Oil packing rings with light engine oil and, using block of wood to prevent scratching sealing surface of seal plate, press seal plate into bearing retainer, with smooth polished surface towards outer side of retainer. Tap block of wood with hammer, if necessary, to seat the plate properly in retainer and so it is parallel with back wall of retainer. There should be a slight springback when seal plate is pressed tightly against back wall of retainer. Install second seal plate in second retainer in same manner.

c. Install Bearing Retainers and Shims. Measure the total thickness of the shims that were removed with retainers if same shims are to be installed. Add shims to one side, if necessary, to make the total thickness of shims to be installed on each side equal or, if new shims are to be used, install retainers at ends of hub with shims totaling 0.060 inch under each retainer (fig. 107). Tighten cap screws in

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Figure 107 – Installing Bearing Retainers and Shims

retainers, then rotate shaft to test bearing adjustment. Remove or add on equal thickness of shims back of retainers to eliminate all end play in shaft and to make a slight drag on bearings when shaft is turned by hand. Both retainers must be tight when checking adjustment. Install lock wire through heads of retainer cap screws after bearings have been adjusted and cap screws tightened.

d. Assemble Oil Seals and Guide Bushings. Install rubber seal boot on seal spring assembly and, using nonvulcanizing rubber cement, cement inner sides of boot to sides of spring assembly (fig. 108). Coat inner face of guide bushing with cement (fig. 109), then install boot and spring assembly in bushing with pins in spring assembly engaging holes in bushing. Lay bushing on bench and coat upper side of seal boot with cement. Set seal ring on dowels projecting from upper side of spring assembly. Place clean cloth over polished surface of seal ring, then place weight on assembly to hold parts tightly together, and allow at least one hour for cement to dry. Repeat these operations on second assembly.

e. Install Guide Bushings. Wipe surfaces of seal rings clean and lubricate them with light engine oil. With wheel standing on floor, turn shaft so mark at tapped end of shaft, which designates position of inner oilholes in shaft, is at top. Two sides of the guide blocks are machined, two are not. Drive bushings onto ends of shaft against

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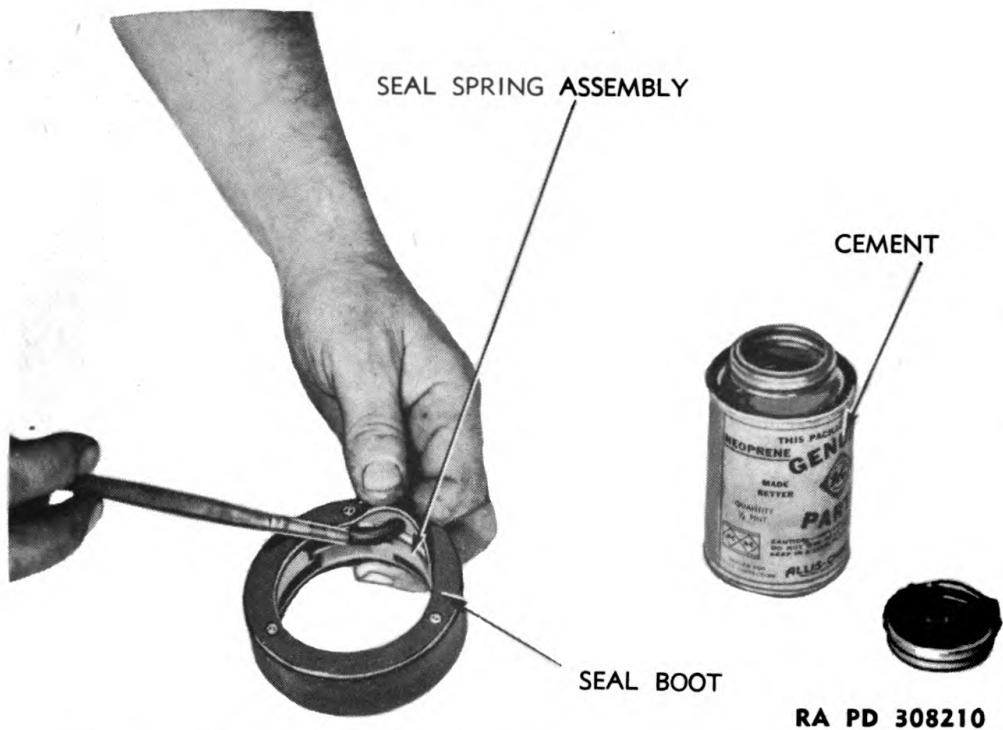


Figure 108 – Cementing Seal Boot to Spring Assembly

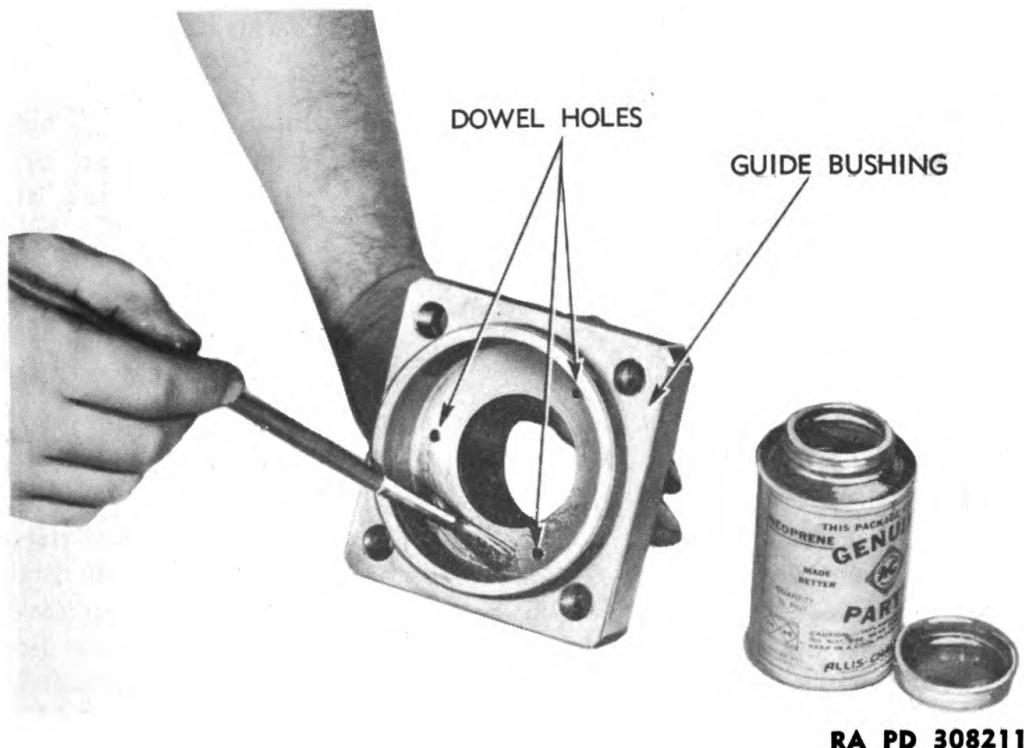
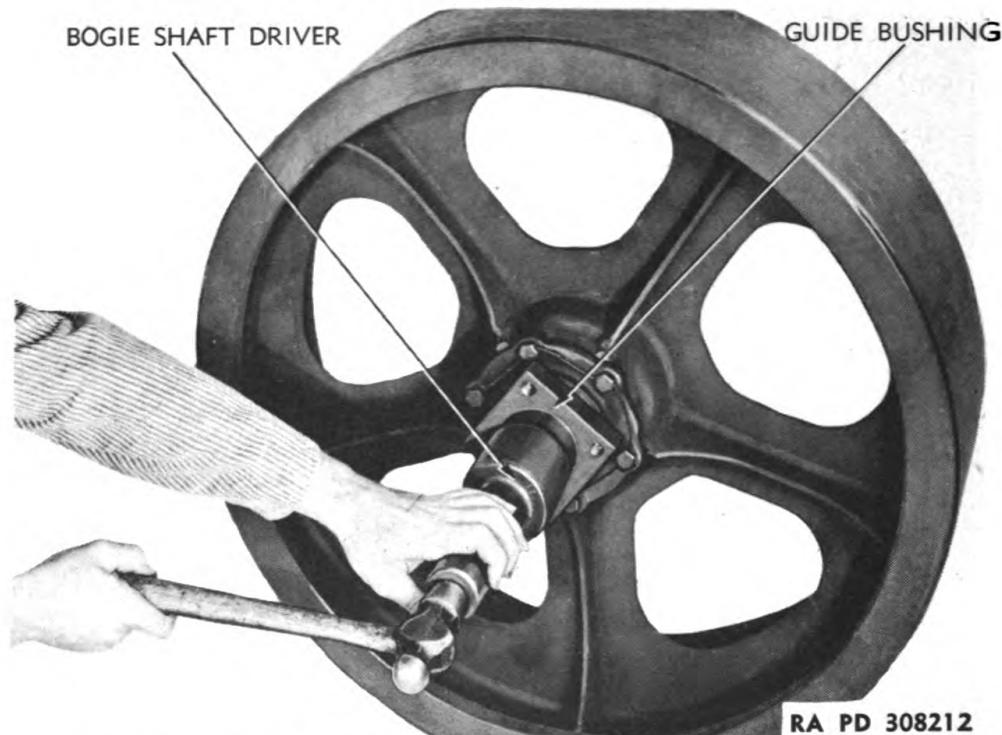


Figure 109 – Coating Guide Bushing With Cement

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RA PD 308212

**Figure 110 — Installing Trailing Idler Guide Bushing,
Using Tool (41-R-2378-598)**

shoulders with one of the machined sides of blocks at top. This will enable wheel to be installed on tractor with oilholes in shaft on upper side. Use replacer (41-R-2378-598) as shown in figure 110 to install the bushings. Using lubricator furnished with tractor, fill wheel with oil and install shaft plug with copper washer.

48. TRAILING IDLER BRACKETS.

a. Figure 111 shows the idler wheel and all parts of the idler brackets. The removal of the major components separately is outlined in TM 9-785.

b. **Trailing Idler Arm.** The trailing idler arm (yoke) pivots on a hinge shaft on two steel wear bushings located in arm. Spring-loaded oil seals in arm prevent loss of lubricant and entrance of dirt or water. Wear or damage to the bushings necessitates the replacement of both bushings and oil seals. The bushings have a press fit in the arm and must be driven out and the new one driven or pressed into place (fig. 112). No reaming is required after installation. After bushings have been installed, press a new oil seal into each side of arm with lip of seal in outer side facing bushing. The lip of seal must be placed in inner side of arm facing away from bushing. This

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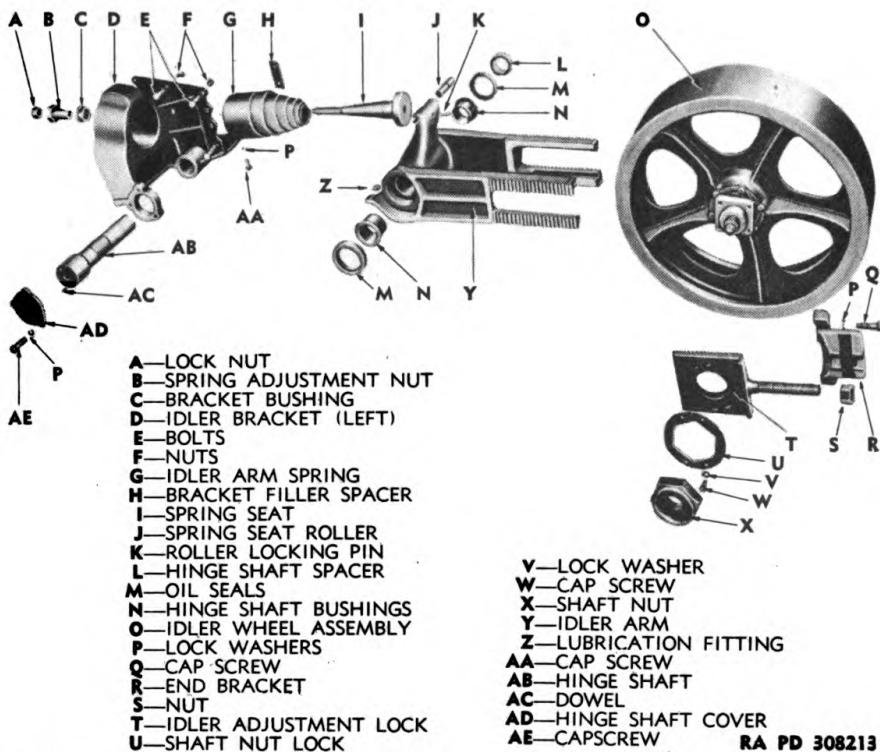


Figure 111 — Trailing Idler Brackets Disassembled

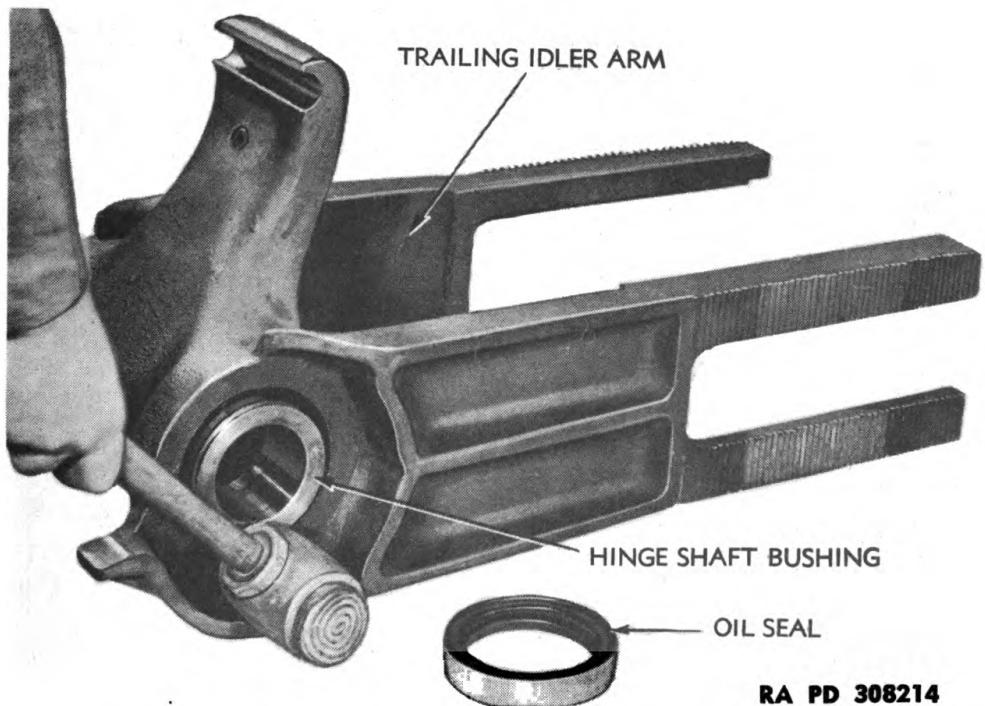


Figure 112 — Installing Trailing Idler Arm Bushing

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arrangement facilitates installation of hinge shaft and prevents damage to seals if tractor is lubricated with high-pressure equipment. Place hinge shaft spacer in arm before installing inner oil seal.

c. Trailing Idler Bracket and Spring. The volute spring in bracket must be replaced if broken or has set to point where two or more coils are in contact with spring seat or bracket. Replace spring seat or adjustment nuts if damaged or if threads in nut or bolt of seat are not in good condition. When installing spring, correct adjustment of spring tension will be made by turning adjustment nut onto bolt of spring seat until $1\frac{1}{16}$ inches of the bolt extends out of bushing.

CHAPTER 7

WINCH AND CONTROLS

Section I

WINCH

49. DESCRIPTION.

a. The winch is a Gar Wood Model Number 4M 718, with 300 feet of $\frac{3}{4}$ -inch cable. It is of the standard heavy-duty, military-type, and mounted in rear end of tractor hull. Drive shafts with universals are connected to the winch worm shaft in winch gear case, and to the power take-off which operates the winch. The winch drum shaft is driven by the worm and gear in gear case, through a sliding jaw clutch operated by the control lever in driver's compartment. This worm and gear reduction provides for maximum pull on cable. An automatic brake on the winch worm shaft holds loads suspended when engine master clutch is disengaged.

b. Instructions for the removal, installation, and adjustments of the winch are given in TM 9-785.

50. DISASSEMBLY OF WINCH.

a. Remove Cable From Drum (fig. 113). Lift winch assembly onto blocks or suitable bench with chain hoist. Unhook line holder from around drum of cable. Unlock cable drum lock at top of gear housing; see that jaws of sliding clutch are disengaged from jaws on

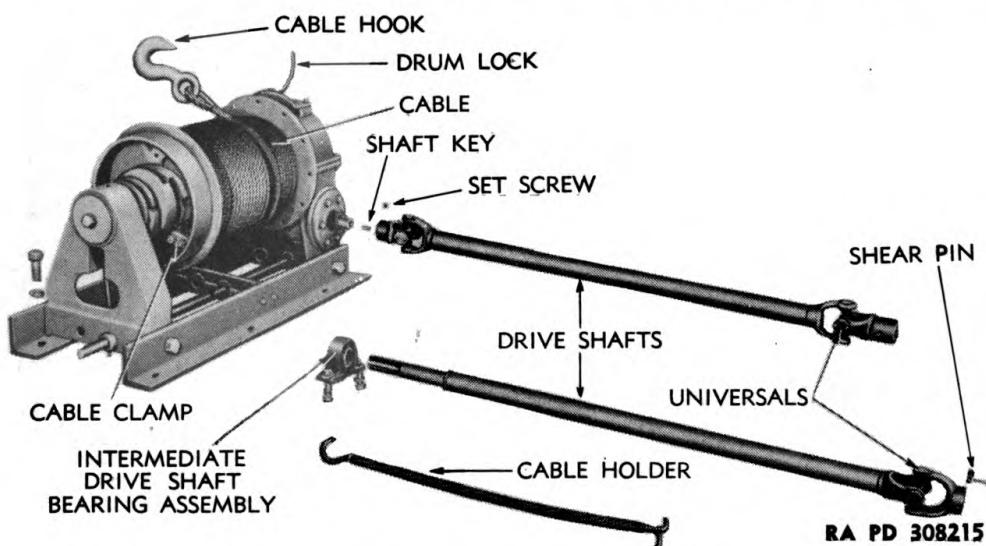


Figure 113 – Winch and Winch Drive Shafts

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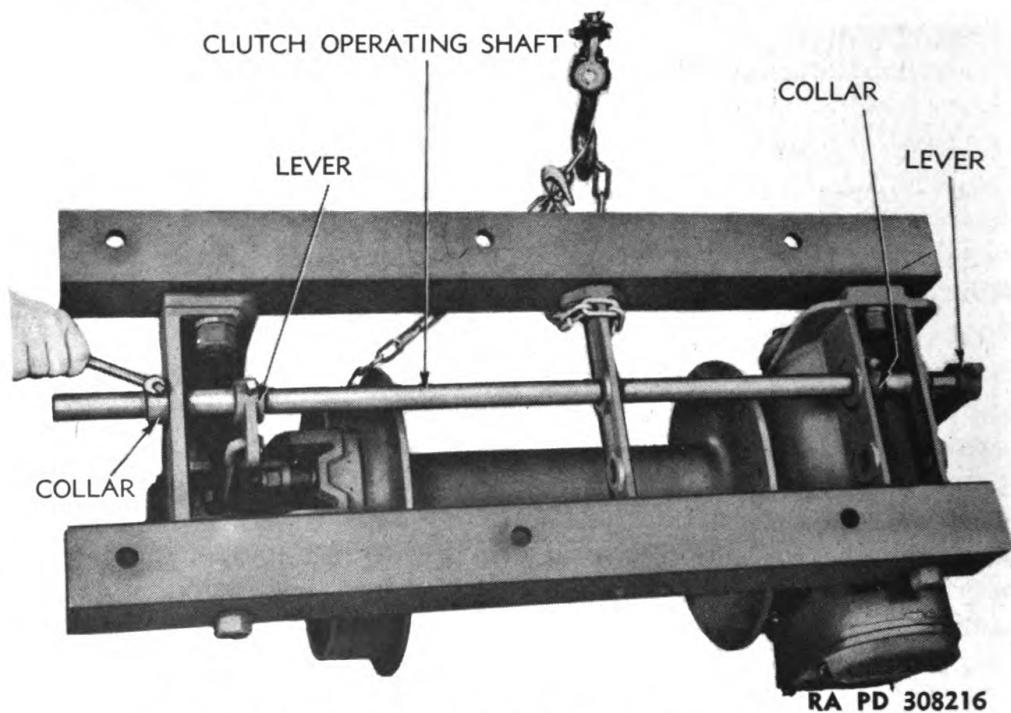


Figure 114 – Loosening Set Screw in Collar

winch drum. Unreel cable from drum until anchored end is exposed, remove cable clamp from drum flange by removing the two nuts, and pull anchored end of cable out from flange.

b. Remove Clutch Operating Shaft Assembly (fig. 114). Turn winch on side with aid of chain hoist. Loosen the three set screws in the short operating lever and the two spacer collars on the clutch operating shaft. Then have one man pull out on gear case end of shaft while another taps clutch lever off opposite end of shaft. Pull shaft on out and remove collars from shaft.

c. Remove Winch Drum and Shaft Assembly. Turn winch right side up. Remove eight bolts from gear case and cover and lift cover from gear case (fig. 115). Remove the two pivot bolts from end frame and winch base angles, attach hoist and chain to winch drum, and lift drum shaft assembly and end frame from base (fig. 116).

d. Disassemble Winch Drum and Shaft Assembly.

(1) Remove cap screw and washer from clutch end of drum shaft. Slide end frame, outer thrust ring, and sliding jaw clutch towards end of shaft far enough for clutch yoke to slip down out of clutch when end frame is removed from shaft. Remove end frame with clutch shifting yoke attached (fig. 126). Remove outer thrust ring and jaw clutch.

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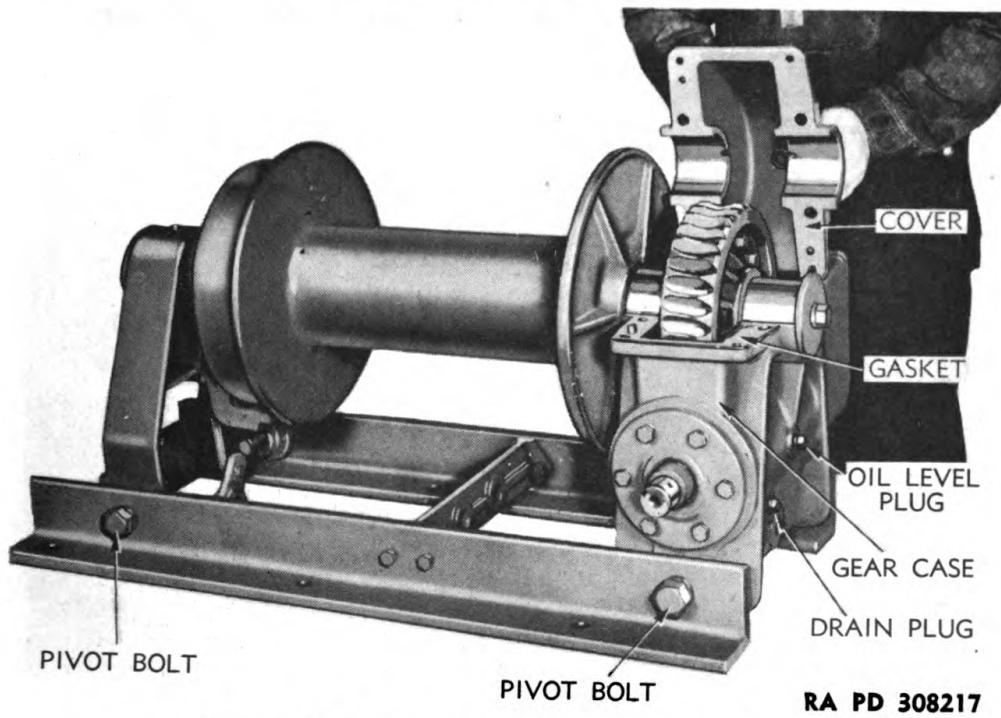


Figure 115 – Removing Gear Case Cover

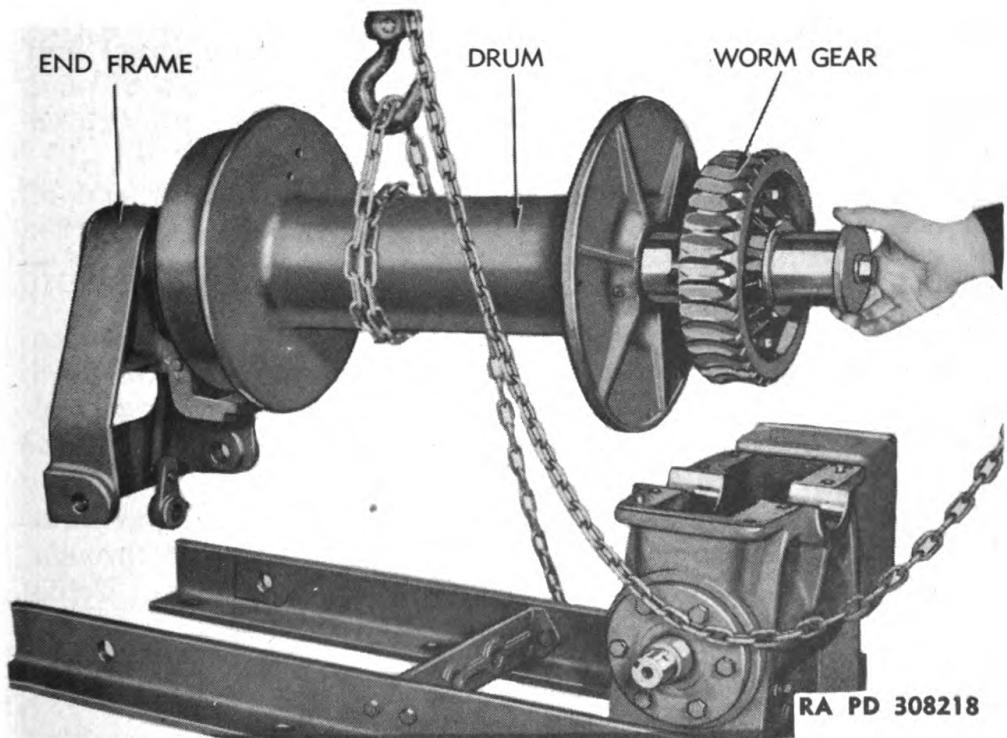


Figure 116 – Removing Drum Shaft and End Frame Assembly

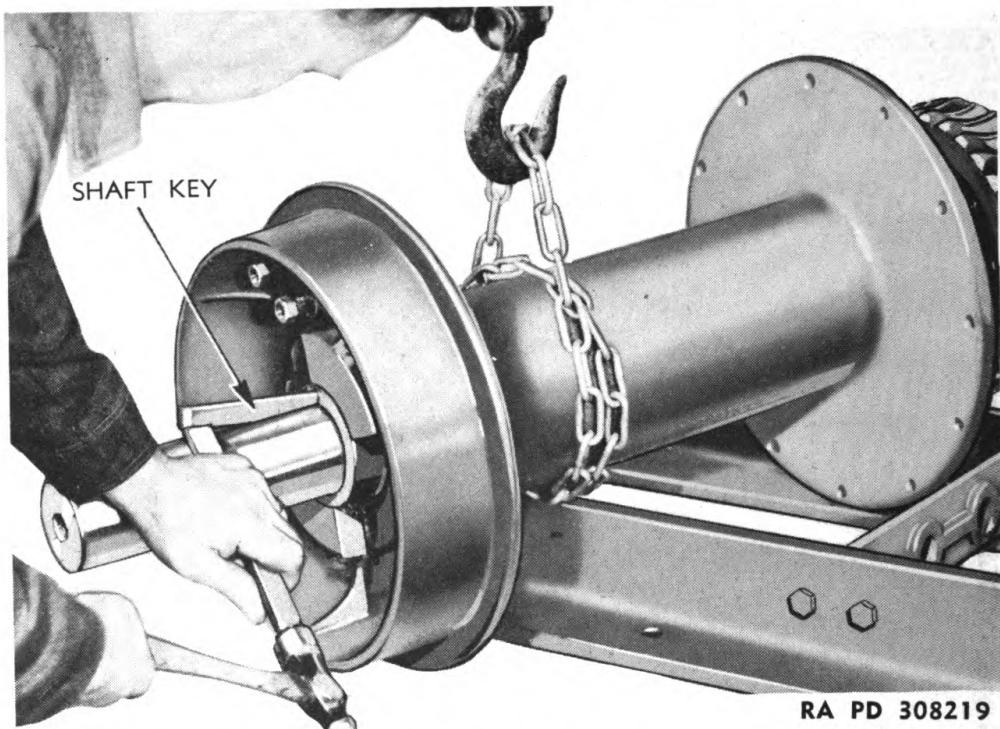
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Figure 117 – Removing Keys From Drum Shaft

(2) Remove the two keys from slots in shaft with chisel and hammer. Keep moving chisel all along key on both sides to raise it evenly out of slot (fig. 117). File off burs made on key by chisel after removing it. Slip inner thrust ring off shaft.

(3) Remove cap screw and retaining washer from gear end of drum shaft, then slide outer drum shaft bushing off shaft (fig. 118). Slide shaft, with worm gear attached, out of drum. Slide inner drum shaft bushing off shaft.

(4) Remove nuts from the 10 bolts holding worm gear to worm gear spider. Tap bolts back with soft hammer till ends are flush with spider, then, using brass punch and hammer, drive them on out. Use care not to damage threads. Tap gear off spider with soft hammer, then place shaft in press and press shaft out of spider.

(5) If drum bushings are to be replaced, remove lock screw from ends of bushing and drum (fig. 119), insert a long punch through drum, and use hammer to drive bushings out of ends of drum. Cable clamp studs may be removed from drum if necessary by screwing two $\frac{1}{2}$ -inch nuts on studs, tightening them against each other and turning studs out.

e. Remove Automatic Safety Brake and Worm Shaft Assembly.

(1) Remove drain plug from gear case (fig. 115) and drain oil from case. Replace plug after oil is drained.

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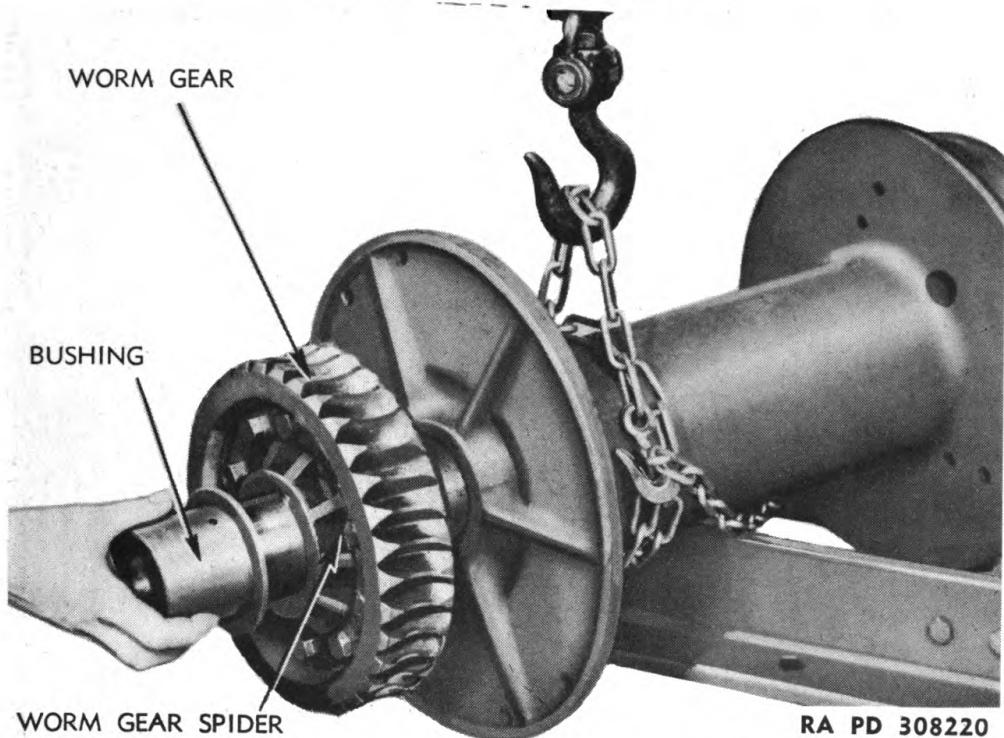


Figure 118 — Removing Outer Drum Shaft Bushing

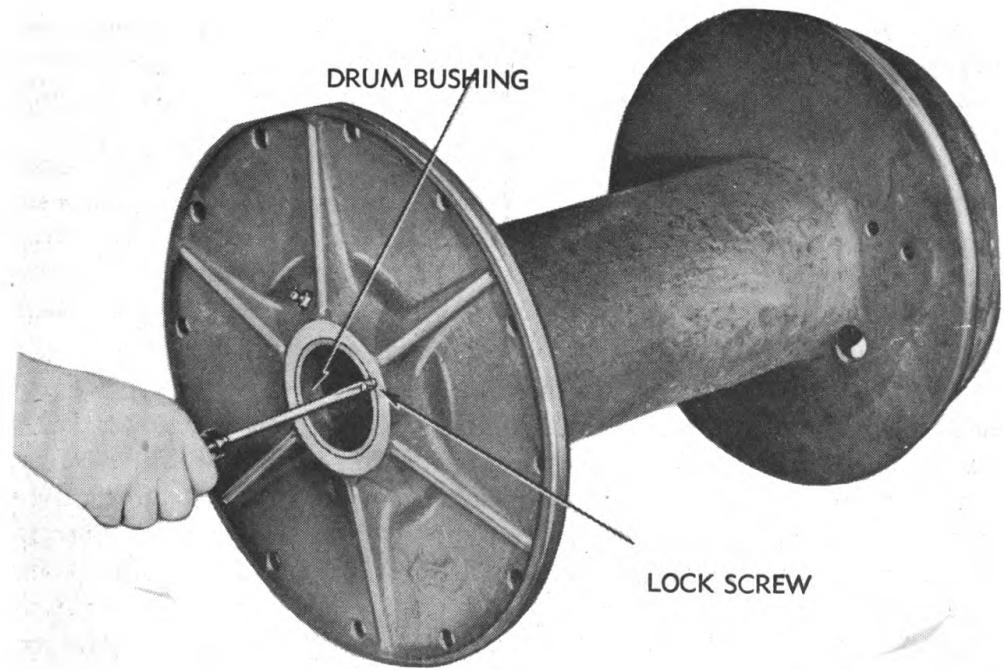
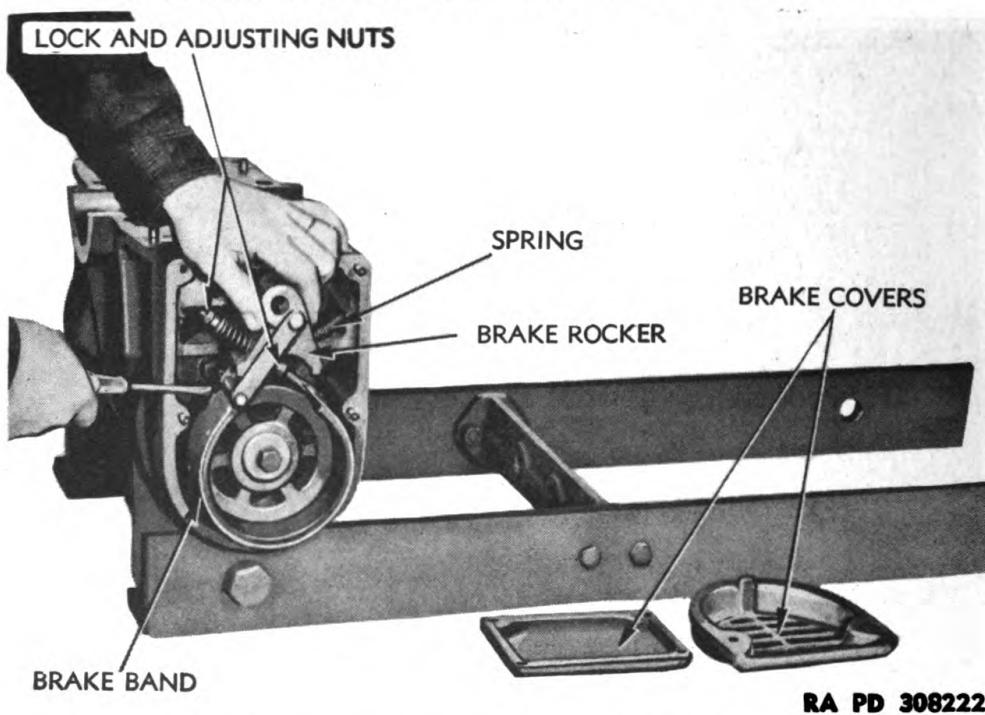


Figure 119 — Removing Drum Bushing Lock Screw

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Figure 120 – Removing Automatic Brake Assembly

(2) Remove the two-section brake housing cover by removing three wing nuts and one thumb screw. Loosen top lock nuts and adjusting nuts on brake band. Pull cotter pin from rocker pin at top of housing and pry brake band assembly from housing (fig. 120). This will also release spring between bell crank and housing.

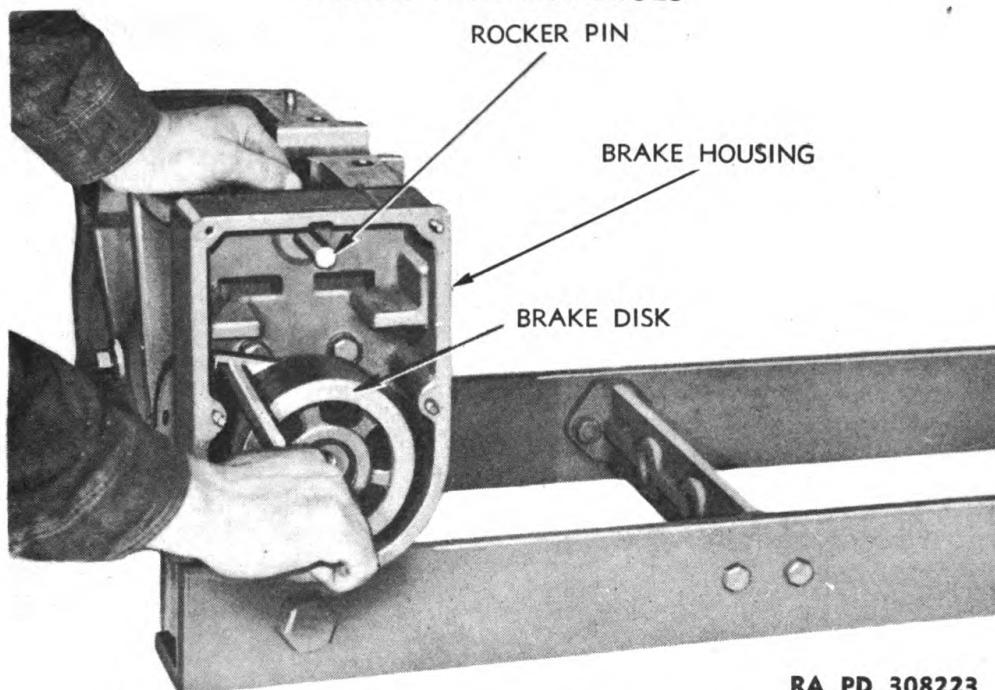
(3) Remove retaining cap screw and washers from end of worm shaft. Pry off brake disk (fig. 121). Remove six cap screws holding brake housing to gear housing and remove brake housing from worm shaft. Drive worm shaft assembly from gear case with soft hammer. Both worm shaft bearings will be removed with shaft. Press bearings off worm shaft (fig. 122).

f. **Disassemble Automatic Brake Assembly** (fig. 125). Remove both nuts, spring alining washer, and spring from threaded end of bands. Pull cotter pins from pins in rocker and end of band and remove pins and links. Remove rocker and spacer from threaded end of band. Remove lower adjusting and lock nuts. Punch rivets out of lining and bands with punch tool of brake lining machine to remove lining from band.

g. **Remove Front Bearing Retainer From Gear Case.** Remove six cap screws from front bearing retainer on gear case and remove retainer and gasket (fig. 124).

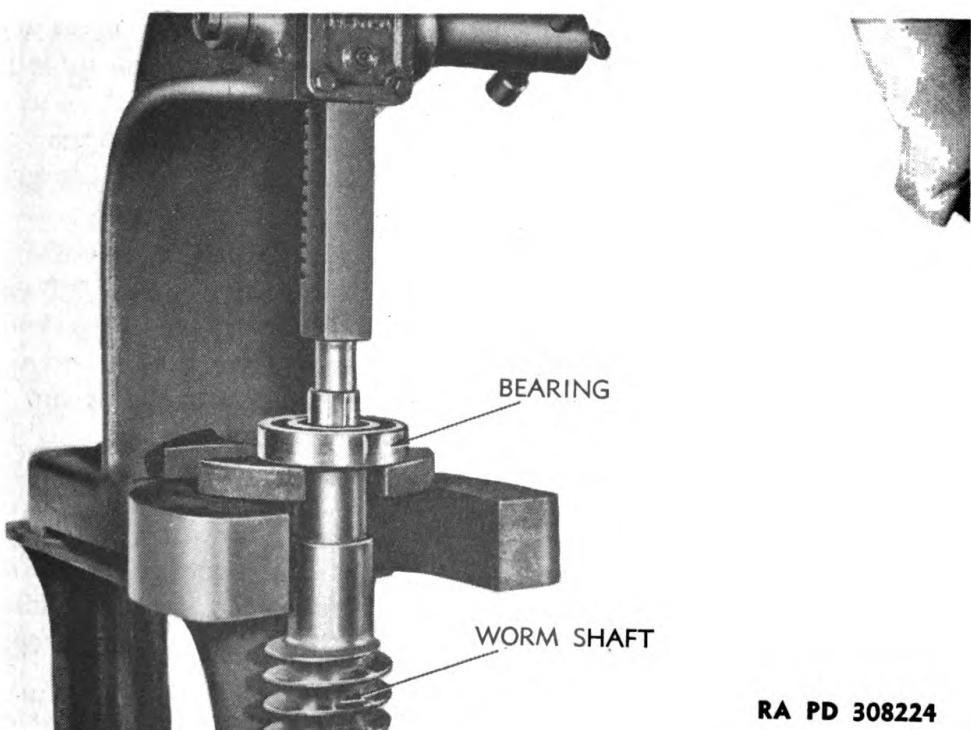
h. **Remove Oil Seals From Brake Housing and Bearing Retainer.** Place brake housing in arbor press. Place a steel disk

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RA PD 308223

Figure 121 — Prying Brake Disk Off Worm Shaft



RA PD 308224

Figure 122 — Pressing Bearing From Worm Shaft

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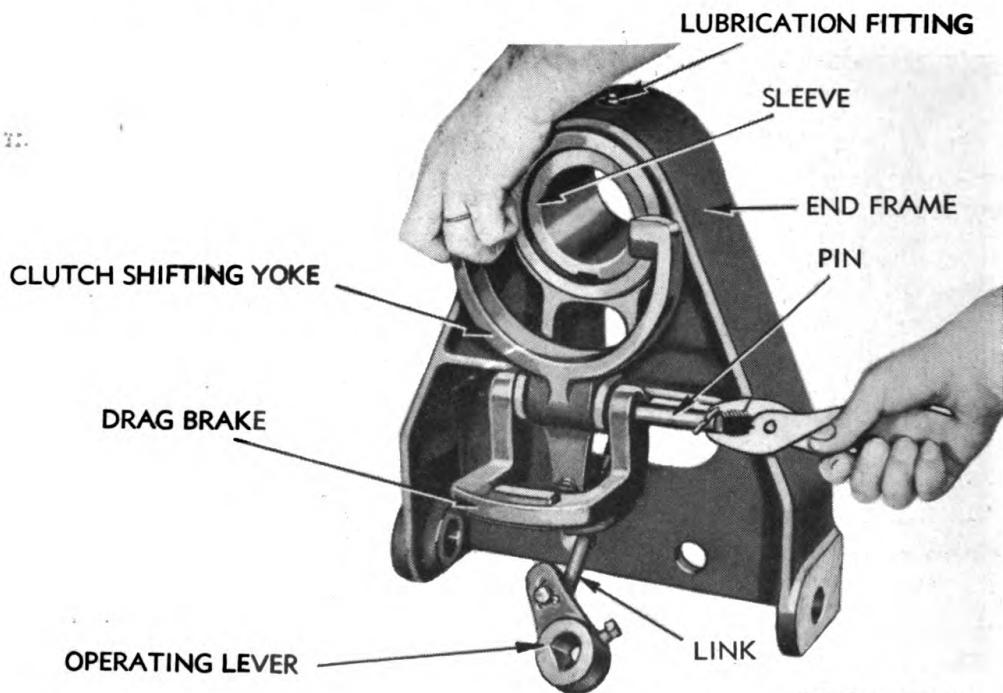


Figure 123 — Removing Clutch Yoke Pin

$\frac{5}{16}$ inch thick and 3 inches in diameter over oil seal and press seal from housing. Remove oil seal from front bearing retainer in same manner.

i. **Remove Gear Housing From Winch Base.** Remove the two large pivot bolts holding gear housing to base angles and lift gear housing from base angles.

j. **Disassemble End Frame** (fig. 123). Pull cotter pin from one end of clutch shifting yoke pin, pull pin from clutch yoke and end frame, and remove yoke. Pull cotter pin and remove operating lever from yoke link. Remove lubricating tube and nipple from sleeve in end frame through hole in top of end frame and slip sleeve out of end frame. Tap dowel pin out of end frame.

51. INSPECTION AND REPAIR OF PARTS.

a. **Cleaning and Inspection.** Clean all parts thoroughly, washing them with dry-cleaning solvent or fuel oil. Inspect all parts for cracks, breaks, or other damage. If cast parts are broken and pulled out of shape, replace them with new parts. Small cracks or breaks may be repaired by welding or brazing.

b. **Gear Case.** Inspect gear case after cleaning it. See that oil grooves and passages in bushings are not clogged. Replace dowel pins that are damaged or, if broken off, drill the broken pieces out and install new dowels.

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c. **End Frame.** Repair broken parts in end frame, if any, or replace assembly. Test wear on end sleeve bushing by working sleeve back and forth against shaft. If there is excessive play between bushing and shaft, replace sleeve bushing.

d. **Drum Assembly.** Inspect drum for cracks or breaks, repair or replace if necessary. Be sure studs in cable clamp are in good condition.

e. **Worm Gear and Drum Shaft.** Replace worm gear if teeth are scored, cracked, or broken. Inspect worm gear spider, replace worn or damaged bolts or spider if damaged. Replace damaged or worn keys in drum shaft. If shaft is bent or damaged, replace shaft. *If a heavy press is available, a bent shaft can be straightened.

f. **Worm Shaft Assembly.** Examine worm teeth for scoring, chipping, or breaks. If teeth are worn to a sharp edge, replace the gear. Due to the pressure on the worm and gear, the teeth on both must be smooth. Replace worm if chipped or cracked teeth are found. Clean ball bearings and rotate the bearing. Discolored or blue bearings indicate overheating and are unfit for further use. Oil bearings with light engine oil and test to see that they roll smoothly. If they do not, replace the bearings. Examine oil seals in brake housing and worm shaft bearing retainer.

g. **Automatic Safety Brake Assembly.** Examine brake disk. If scored, place disk in lathe and smooth brake surface. If linings are worn nearly to rivet heads, replace lining on brake band. Use a brake lining machine to punch out the rivets to remove lining and install a new lining, of the original thickness and of the special kind provided for winch brakes. If lining is not worn but is grease soaked, wash grease out of lining with dry-cleaning solvent. Make sure all brake pins, and linkage work freely. Replace worn brake pins and linkage. Make sure the threads on band end and in adjusting nuts are not damaged.

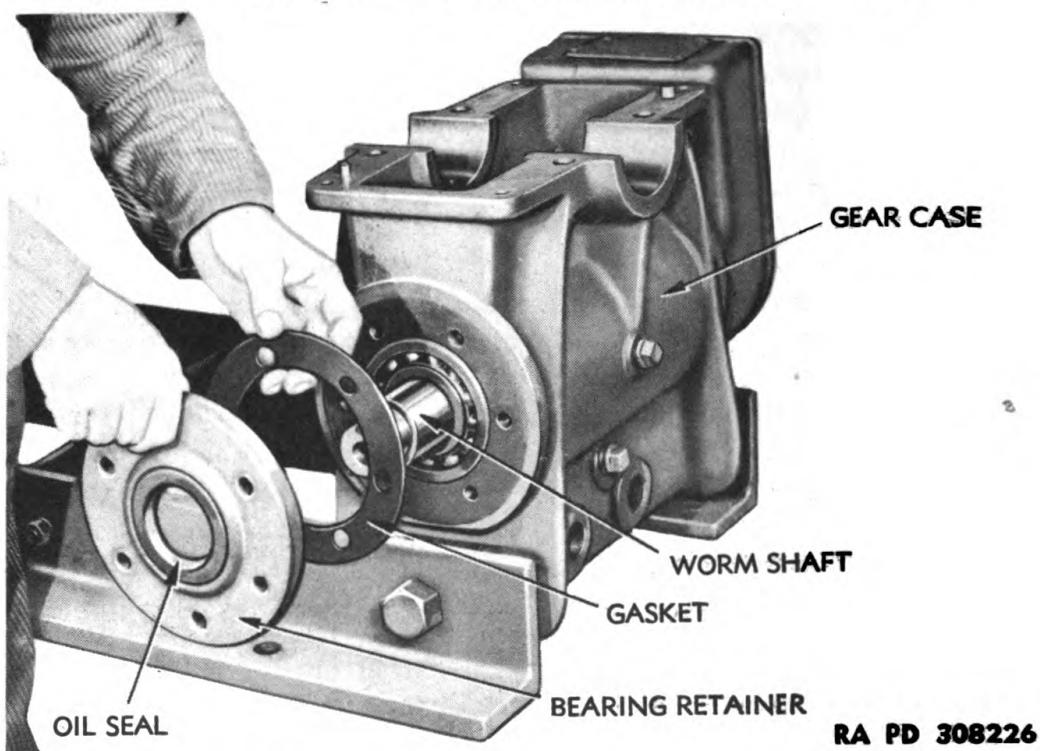
h. **Main Frame.** Repair any cracks or breaks in main frame by welding. Replace frame if twisted out of shape. Straighten clutch operating shaft if bent. Replace spacing collars if threads in collars or on set screws are damaged.

i. **Cable.** Replace cable end if broken. If cable is frayed in any one place or strands broken, replace with new cable. Take care not to take hold of frayed cable with bare hands as hands can be cut or pierced easily by so doing.

52. ASSEMBLY OF WINCH.

a. **Connect Cross Bar and Base Angles.** Connect cross bar to side angles of winch base with four bolts with lock washers as shown in figure 121. *NOTE: The holes in cross bar are closer to one edge of bar than the other. The edge closest to holes must be at bottom*

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RA PD 308226

Figure 124 – Installing Front Bearing Retainer

when installed. Do not tighten nuts or bolts until after gear case and end frame have been installed and shaft alined with gear case and end frame.

b. Install Gear Case in Base. Lower gear case into base with drain and level plugs towards outside of base. Insert the two large pivot bolts through base angles and ends of gear case, then turn base on side and install lock washers and nuts on bolts. Do not tighten firmly until after end frame and drum shaft have been installed and case alined with shaft.

c. Assemble and Install Worm Assembly. Using arbor press, install a bearing onto each end of worm shaft with numbers on bearings facing ends of shaft. Install worm assembly in gear case with end of shaft with tapped hole at right end of gear case (looking at gear case from drain plug side). Tap shaft and bearings into case with soft hammer and brass punch so that bearings are flush with outside of case (fig. 125).

d. Install Automatic Brake Housing. Press new oil seal into housing if old seal was removed. Start seal into case with lip of seal to face worm and place housing in press. Lay a steel disk $5\frac{1}{16}$ inch thick and 3 inches in diameter on seal and press seal into housing until flush with outer side of housing. Shellac gasket to gear case

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and install housing on gear case (fig. 121) with six cap screws with lock washers.

e. Install Front Bearing Retainer. Press oil seal into retainer with lip of seal facing attaching face of retainer, in same manner as in subparagraph **d**, above. Shellac gasket to gear case and install retainer on gear case with six cap screws with lock washers (fig. 124). Use care not to damage oil seal in installation.

f. Install Automatic Brake Disk. Tap key into slot in worm shaft. Line slot in brake disk with key in shaft and drive brake disk onto shaft with soft hammer (fig. 121). Install retaining cap screw with plain washer and lock washer in end of shaft and tighten securely.

g. Assemble Automatic Winch Worm Safety Brake Assembly (fig. 125). With lining installed on band, screw lower adjusting nuts on threaded end of band. Slip spacer on next, small end up. Install brake rocker on threaded end of band and over small end of spacer, then brake spring, washer, and upper adjusting nuts. Install band end links with pin through lower part of links and brake band and another pin through upper end of links and brake rocker. Secure pins with cotter pins.

h. Install Brake Band Assembly. Start rocker onto rocker pin and band assembly onto brake disk at same time (fig. 120). Compress rocker spring and place it in position with one end on dowel in brake housing and other end on dowel on brake rocker. Tap brake assembly into place on rocker pin and brake disk. Install cotter pin in rocker pin. Brake must be adjusted after winch is installed as explained in TM 9-785. Install covers with three wing nuts and one thumb screw.

i. Assemble Drum Shaft Assembly.

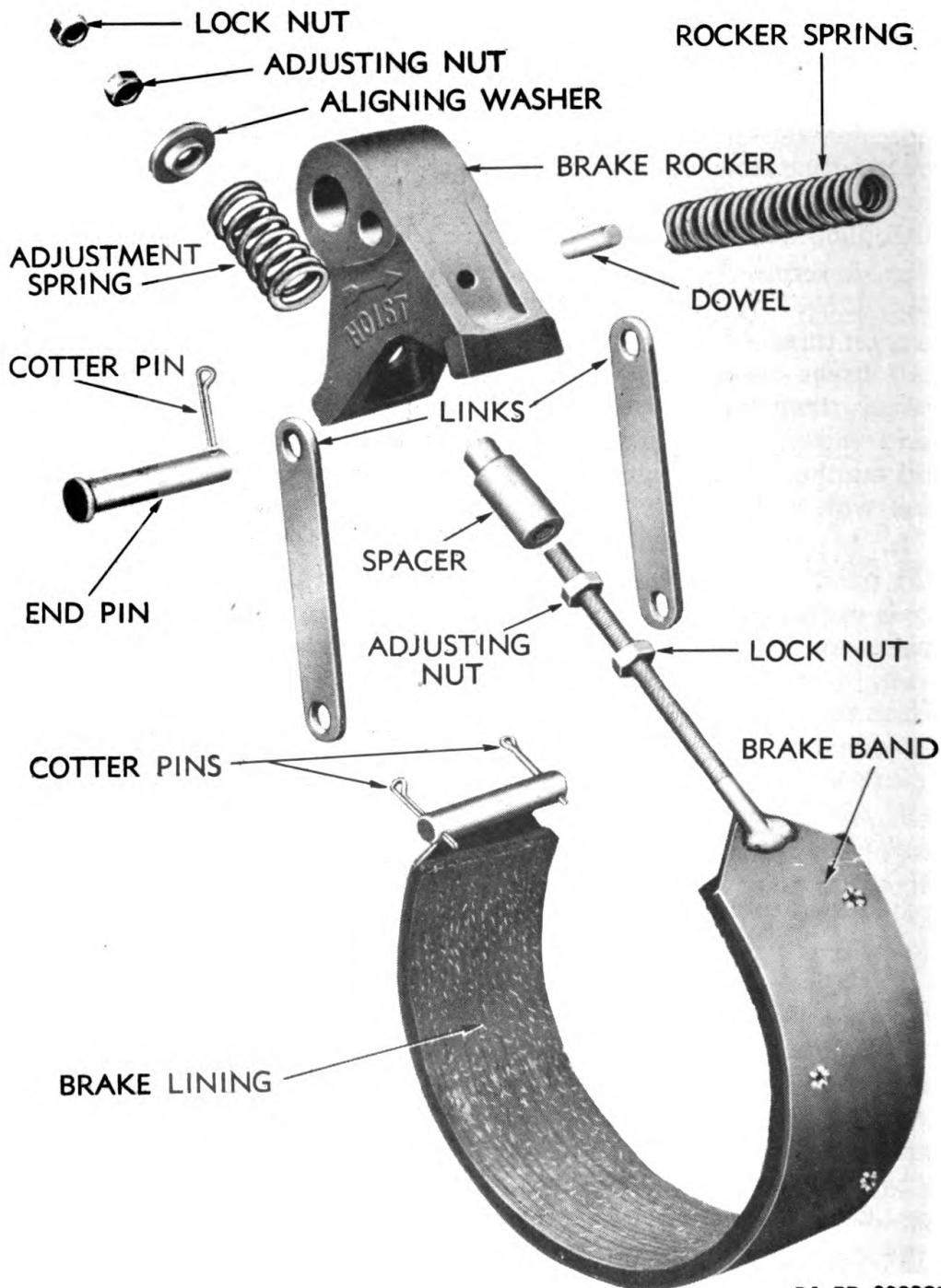
(1) Install two keys in slots on gear end of drum shaft, tapping them into place with hammer. Lock keys by burring edge of keyway against key with a center punch and hammer. File off any burs on key with a flat file.

(2) Coat end of shaft with white lead for lubrication and start worm gear spider onto shaft with gear attaching face of spider away from other end of shaft. Press spider onto shaft with arbor press until hub covers keys.

(3) Install worm gear on spider with wide rim towards outside. Install 10 bolts through gear and spider and install and tighten nuts as tightly as possible. Use special bolts provided, as substitute bolts are likely to shear, and damage to gear will result.

(4) Using wood block against bushings, drive a bushing into each end of drum (fig. 119) with oilhole in bushing in line with lubricating fitting in drum. These bushings have threaded half holes in their outer ends. These must line with similar threaded half holes in winch drum when installing the bushings so that when the bushings are in

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RA PD 308227

Figure 125 – Automatic Safety Brake Disassembled

WINCH AND CONTROLS

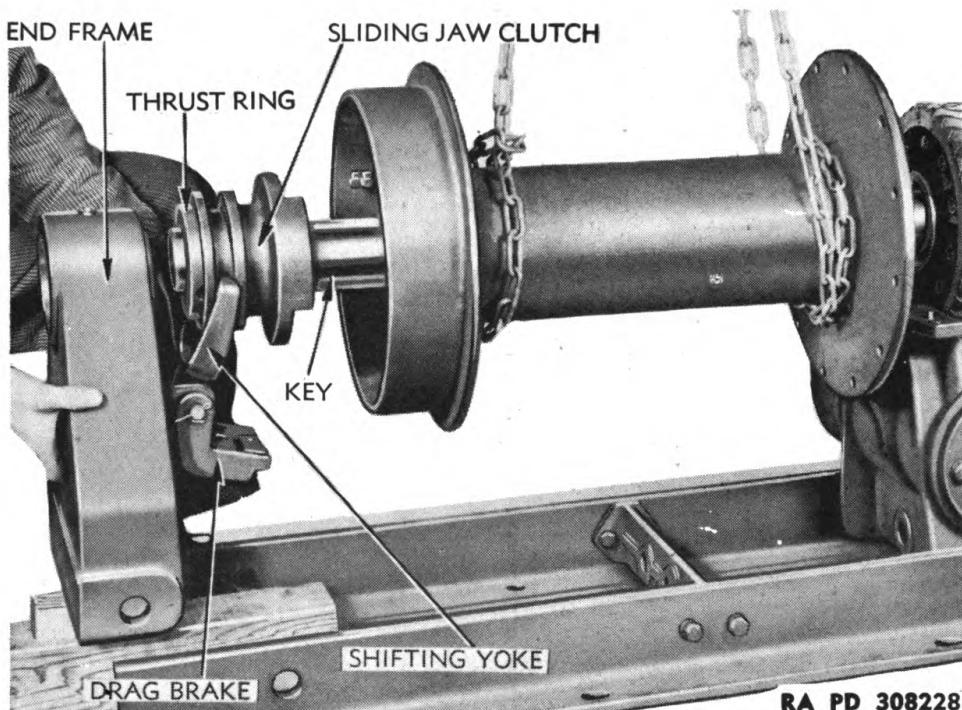


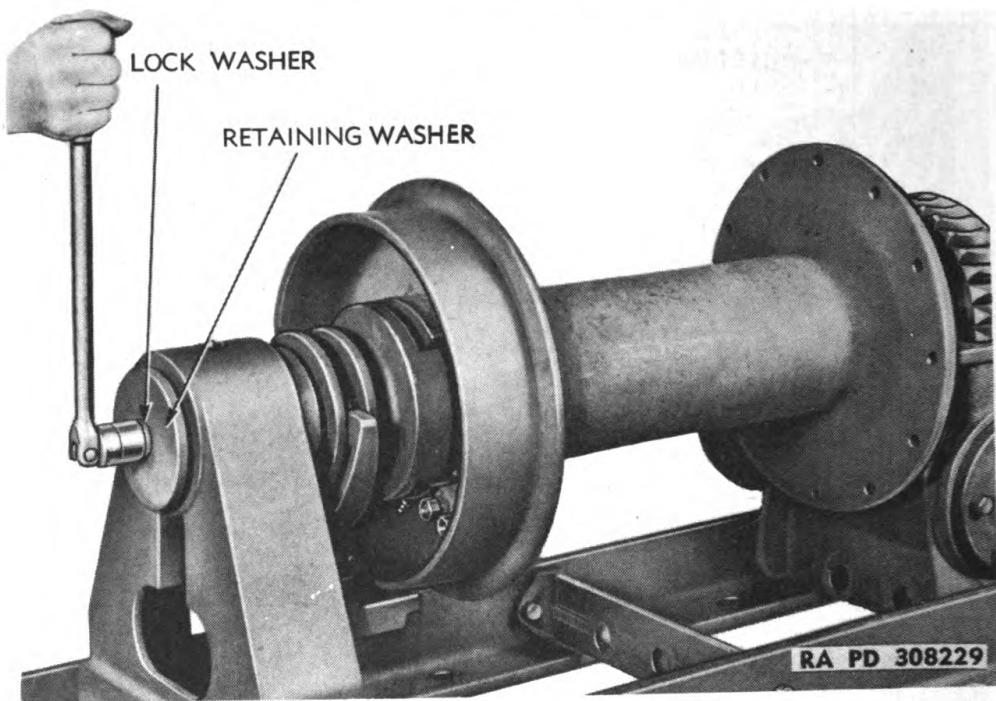
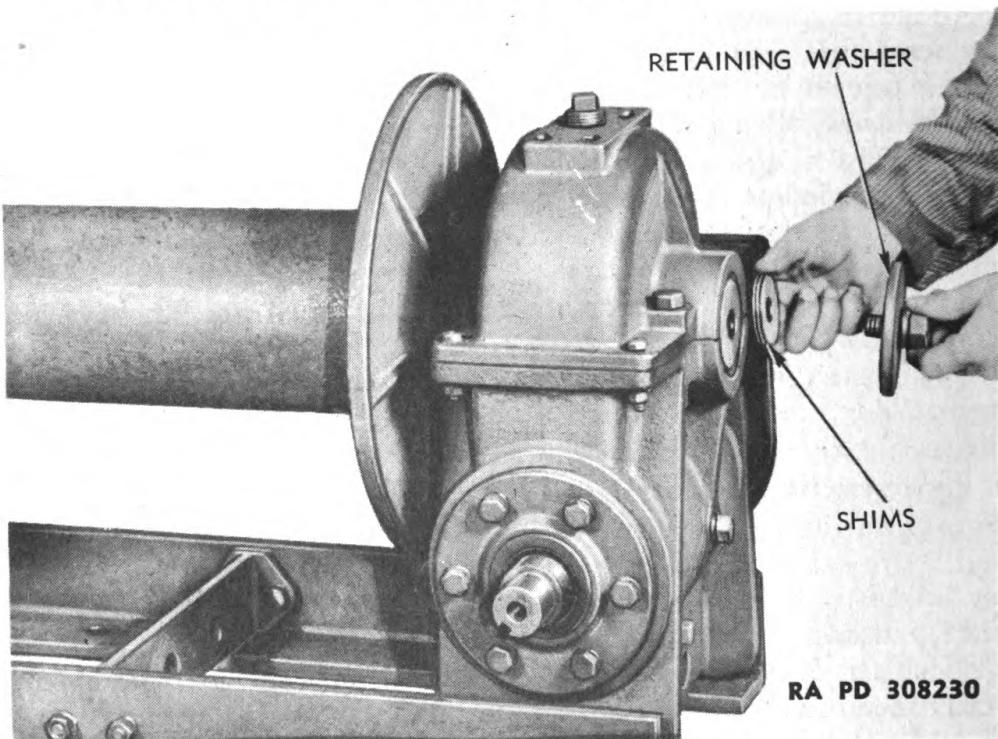
Figure 126 – Installing End Frame Assembly on Drum

place, the two half holes will be together and locking screw may be installed to prevent bushings from turning (fig. 119). Install locking screw. If installing new bushings, this hole in bushing may need to be tapped or hole drilled for passage of grease. Install cable clamp studs in end of drum, if removed.

(5) Slip a drum shaft bushing on shaft at each side of worm gear with flanges towards gear (fig. 118). Insert shaft through drum from end of drum opposite cable clamp. Slip inner thrust ring onto clutch end of shaft with notches facing end of shaft. Make sure there are no burs on keys or in slots in shaft, then tap two keys into slots in shaft (fig. 117).

(6) Install the sliding jaw clutch onto shaft with jaws toward drum and make sure clutch slides freely over keys. Slip outer thrust ring on shaft with notches engaging ends of keys (fig. 126).

j. **Assemble and Install End Frame on Drum Shaft** (fig. 123). Tap dowel into lower side of hole in end frame. Insert sleeve into end frame with slot in sleeve registering with dowel. Install nipple for lubricating fitting in hole in upper side of sleeve. Install shifting yoke and drag brake on end frame with clutch yoke pin. Secure pin with cotter pin. Install short operating lever and link on shifting yoke; secure with cotter pins. Slide thrust ring and jaw clutch close to end of shaft. Install end frame assembly onto shaft, engaging shifting yoke in groove of sliding clutch as end frame is raised to slip onto end of shaft (fig. 126).

ORDNANCE MAINTENANCE – POWER TRAIN, SUSPENSION, AND EQUIPMENT FOR 18-TON HIGH SPEED TRACTOR M4**Figure 127 – Installing Drum Shaft Retaining Washer****Figure 128 – Installing Drum Shaft Retaining Washer and Shims**

WINCH AND CONTROLS

k. Install End Frame and Drum Shaft Assemblies.

(1) Lift assembly with chain hoist, then lower assembly into winch base and gear case (fig. 116). Turn drum shaft bushings at gear end of shaft so dowel holes in bushings will register with dowels in bushing recesses in gear case. The larger holes in bushings are for passage of grease and must be at top.

(2) Install two large pivot bolts in bottom of end frame and winch base but do not tighten bolts. Install retaining cap screw with large thrust washer and lock washer in clutch end of shaft (fig. 127).

(3) Coat both sides of gear case cover gaskets with shellac and install cover on gear case (fig. 115) with four bolts close to shaft and four bolts in corners of cover and gear case.

(4) Install retaining washer with large thrust washer and lock washer in gear end of shaft. Place sufficient quantity of shims between end of shaft and thrust washer (fig. 128) to prevent binding of shaft with end frame or gear case. A very small amount of end thrust of shaft is allowable.

(5) Install drum lock on top of gear case (if it was removed), with two cap screws and lock washers. Countersunk screws go in holes toward drum.

(6) Tighten pivot bolts at lower end of end frame and gear case and tighten bolts in cross bar and base angles.

l. Install Clutch Operating Shaft (fig. 114). Install long lever on end of shaft and tighten set screw. Install shaft in winch. Slip the spacing collars and clutch yoke operating lever on shaft in positions shown in illustration as shaft is inserted through base. Position shaft with inner side of long lever at end approximately 3 $\frac{7}{8}$ inches away from base of gear case, then slide collars against base of gear case and end frame as shown and tighten set screws. Set clutch yoke lever on shaft so yoke link will set perpendicular and tighten set screw.

m. Lubricate Winch Assembly. Make sure drain plug is tight and all lubricating fittings have been installed, then remove filler plug and level plug and fill gear case to level of filler plug with lubricant specified in lubrication chart. Install filler and level plugs. Lubricate all bushings through lubrication fittings with chassis grease and use oil can to lubricate sliding clutch and operating shaft.

n. Install Cable on Drum. Follow instructions in TM 9-785 for installing cable.

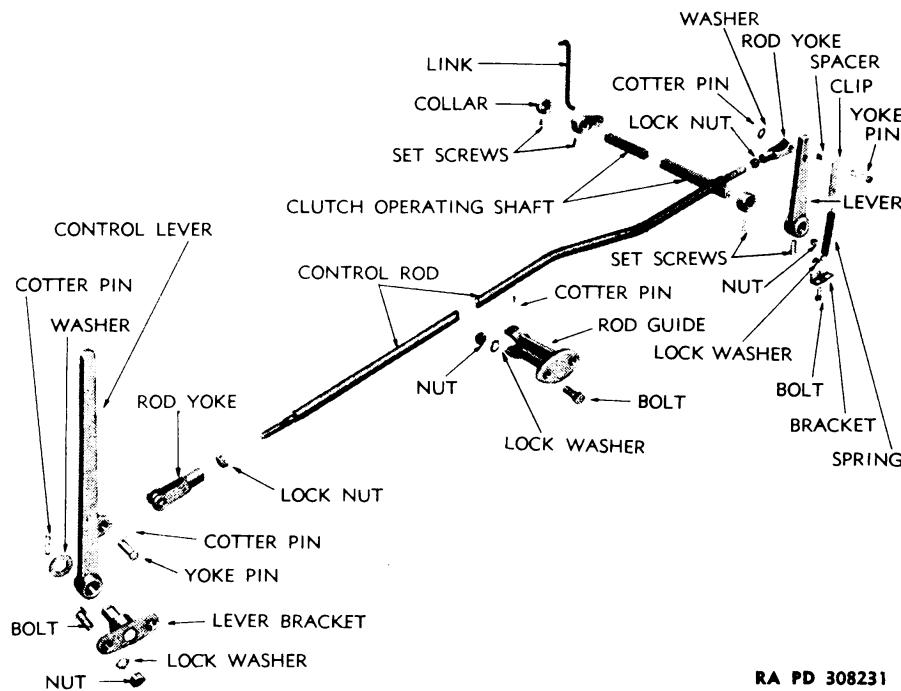
Section II

WINCH CONTROLS AND DRIVE SHAFT

53. WINCH CONTROLS.

a. The winch clutch lever on left fender of tractor is used to engage or disengage the sliding jaw clutch of the winch. A control rod ex-

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RA PD 308231

Figure 129 – Winch Controls Disassembled

tends from this lever to a lever on the end of the winch clutch operating shaft. The control rod is supported between levers by a rod guide bolted to hull of tractor. Threaded yokes on ends of control rod provide a means of adjusting the rod to effect full engagement or disengagement of the jaws of sliding clutch with jaws on the winch drum.

54. WINCH DRIVE SHAFT AND UNIVERSALS.

a. Description. The winch drive shaft assembly consists of two shafts and three cross- and yoke-type universal joints (fig. 113). The front drive shaft is connected to the power take-off, the rear shaft to the winch worm shaft. The rear end of the front shaft is supported by a floating bearing held in a bracket bolted to inside of hull and the two shafts are connected by a slip-joint universal. The shear pin used to connect the front universal to the power take-off shaft and turn the drive shaft is a safety feature to prevent damage to the winch or power take-off gears.

b. Disassembly of Universal Joints. Remove the four covers from yokes by removing two screws from each. Place blocks under yoke as shown in figure 130 and drive down on other yoke. This will drive bushing out of one side of yoke (fig. 130). Turn universal over and drive opposite bushing out in same manner. Remove yoke

WINCH AND CONTROLS

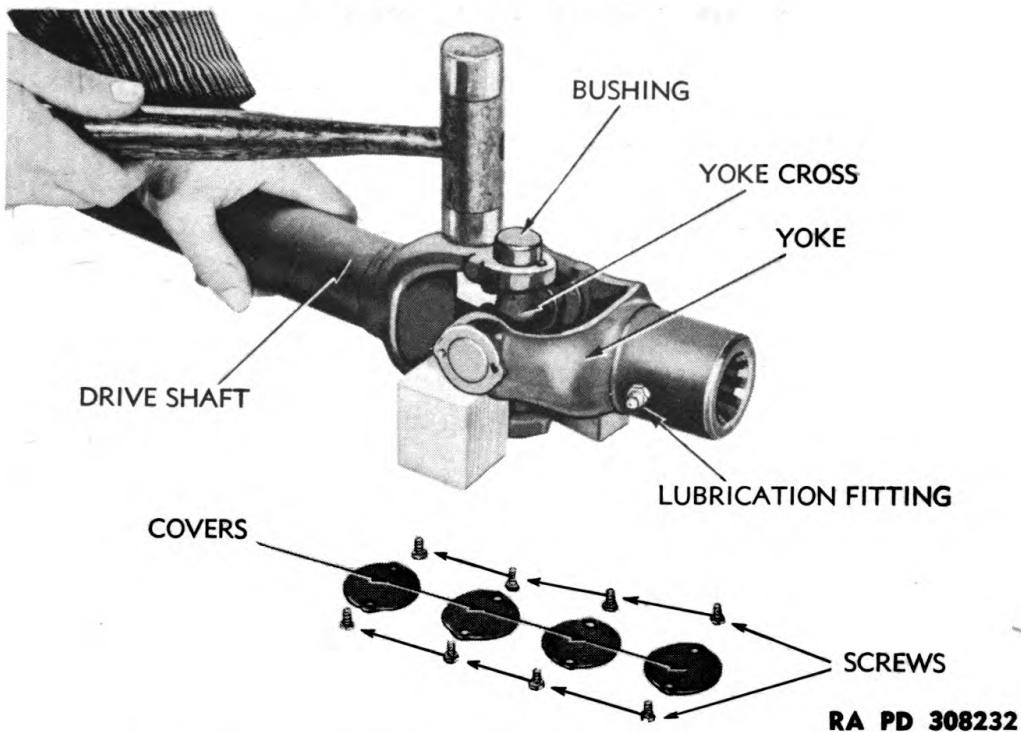


Figure 130 — Driving Bushings From Universal

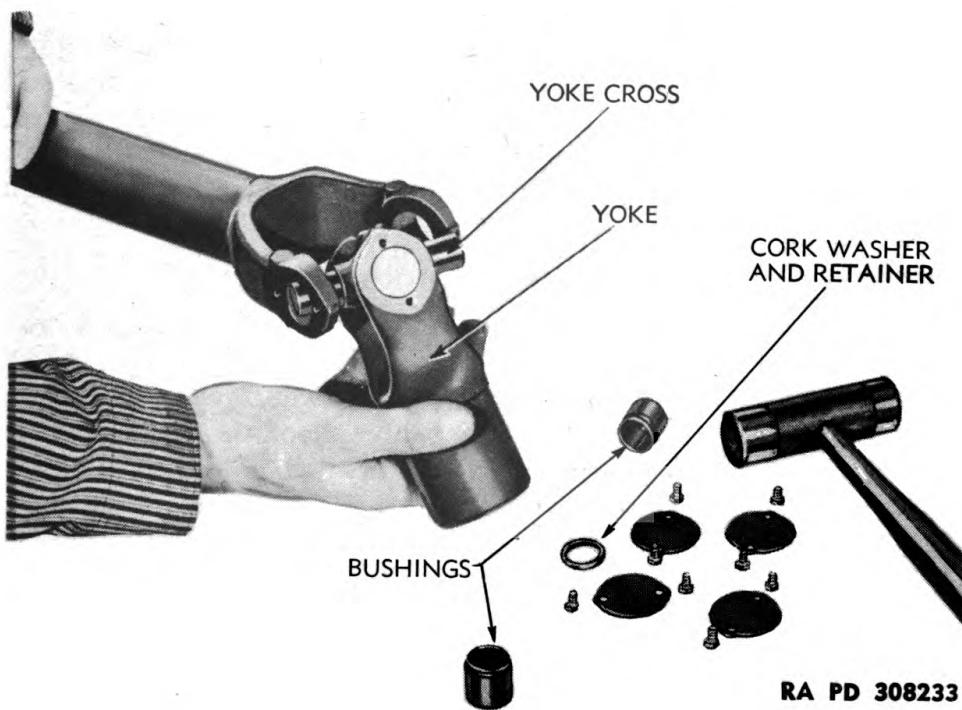


Figure 131 — Removing Yoke and Cross From Shaft

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and cross from shaft or yoke (fig. 131), then remove the two bushings from second yoke in same manner. Remove cork washers and retainers.

c. Inspection of Parts. Replace all cork seal washers removed from universal. If bushings or yoke cross are worn, they must also be replaced. Clean oil passages in yoke cross to make sure lubricant will be supplied to all bushings when universal is again assembled. Inspect splines in slip joint and winch drive shaft, replace units if damaged or if splines are worn enough to allow whipping of shaft. Make sure slip joint slides freely on shaft splines. Straighten or replace drive shafts, if bent.

d. Assembly of Universal Joints. Place yoke cross in yoke of universal. Insert cork washer retainers through holes in yoke and onto arms of cross. Insert cork washers through holes in yoke and onto cross arms. Slide bushings through holes and onto cross arms, then slip cork washers onto ends of bushings and press washers into their retainers. Install covers over bushings on outer sides of yoke with two screws in each. Install cross into shaft yoke, then install retainers, cork washers, bushings, and covers in same manner.

CHAPTER 8

POWER TAKE-OFF

55. DESCRIPTION.

a. The power take-off is mounted on the transmission case and is driven by the high range pinion in the transmission. It is of the reversible-type which provides for turning winch drum in either direction to wind cable on drum or unwind cable from drum. A sliding pinion in the power take-off permits shifting the power take-off into winding, unwinding, or neutral position. It is operated by the control lever located between the steering levers.

b. Removal and installation of the power take-off assembly is given in TM 9-785.

56. DISASSEMBLY.

a. Remove Shifter Shaft Assembly. Remove two cap screws and lift steering lever return spring bracket from top cover (fig. 132). Remove the two cap screws remaining in cover and lift off top cover. Remove shifter shaft spring and plunger from hole in case. Bend lock away from cap screw head and loosen clamp screw in shifter fork (fig. 133). Drive shaft back through case and out of shifter fork. Cover over rear of shaft will be pushed out of case as shaft is removed. Lift spacer and shifter fork from shaft as they are freed. Drive oil seal (fig. 134) out of case.

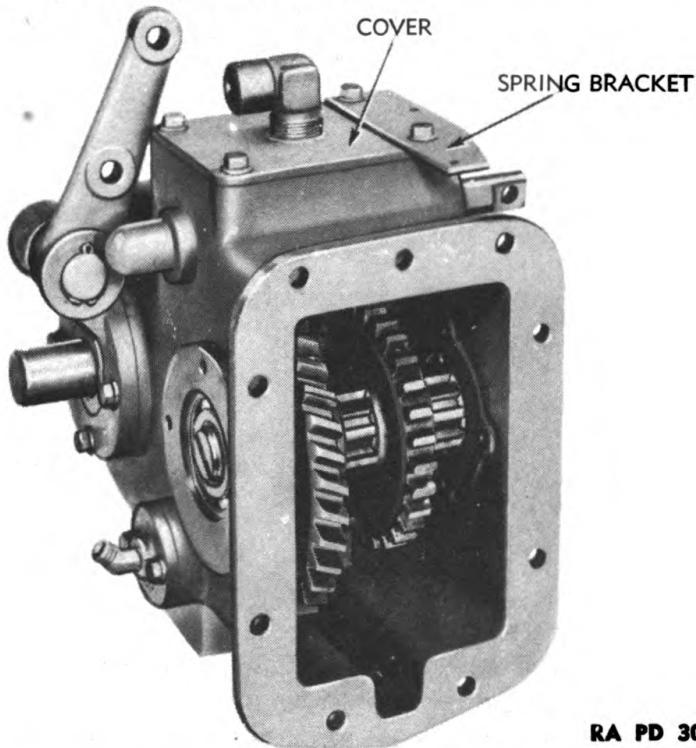


Figure 132 — Power Take-off Assembly

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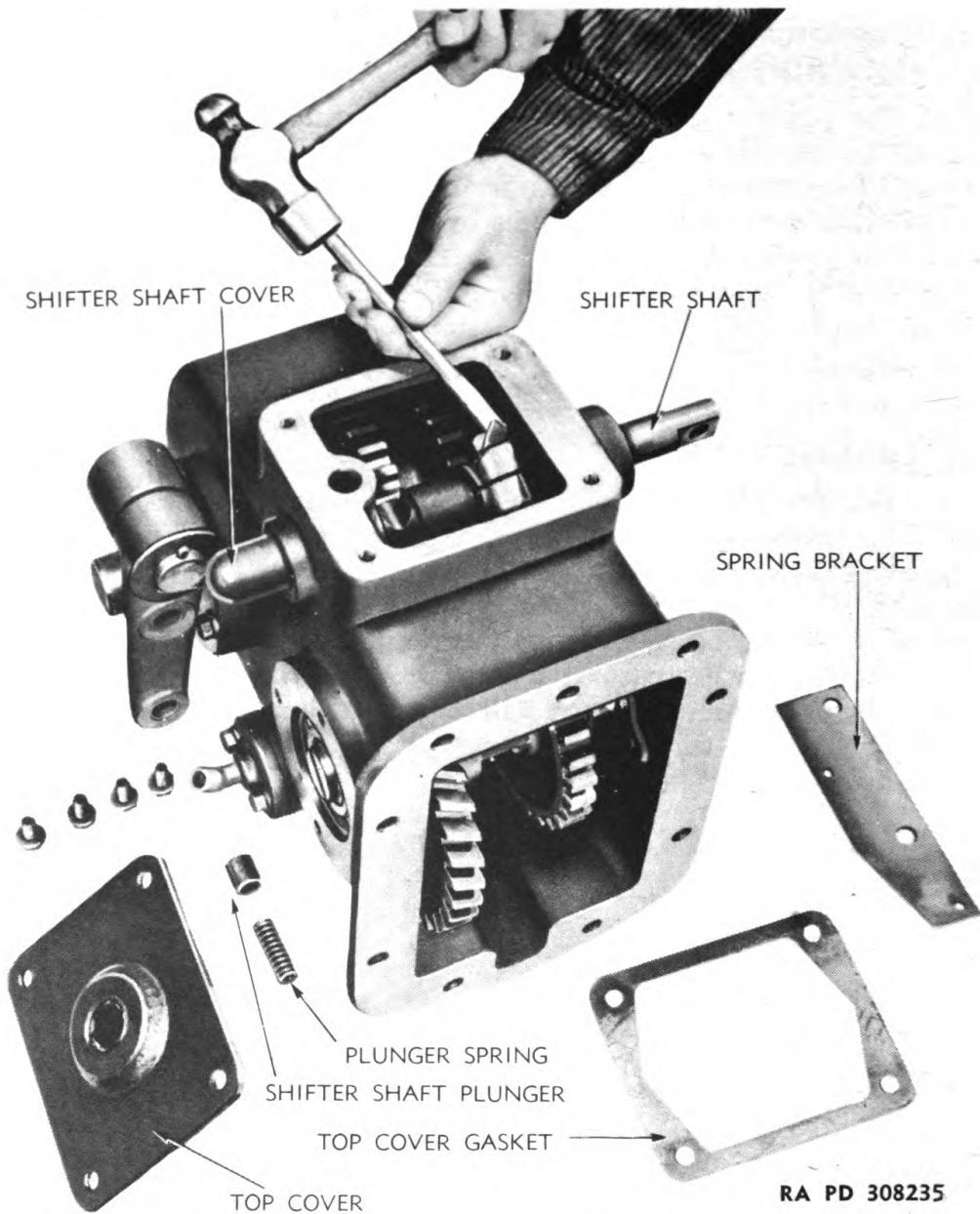
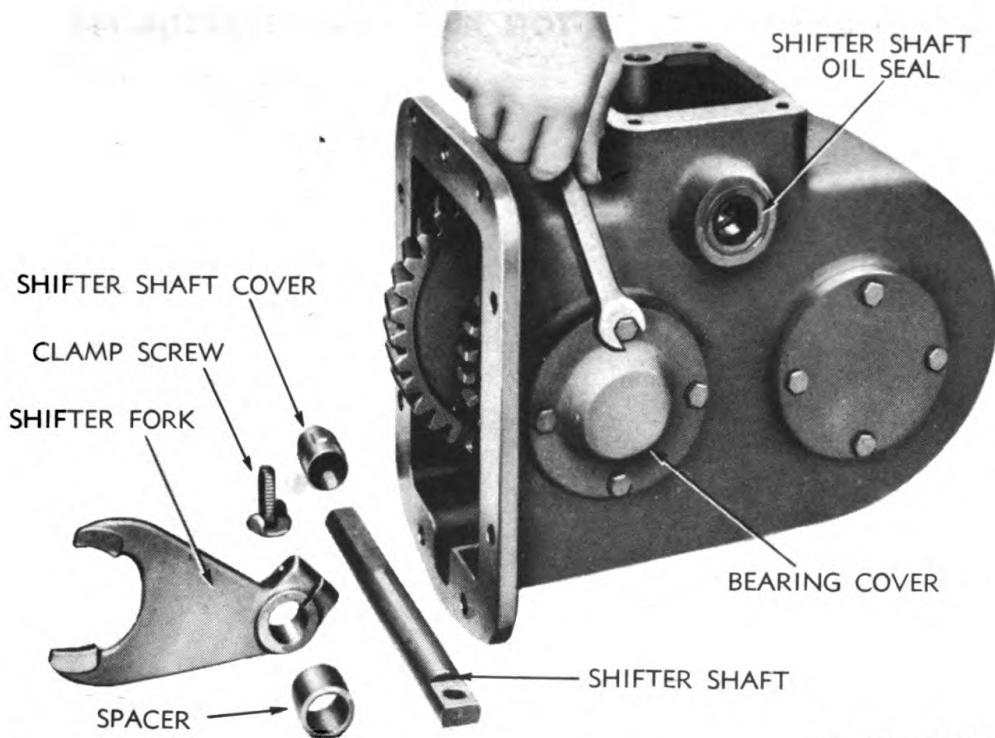


Figure 133 – Removing Power Take-off Shifter Shaft

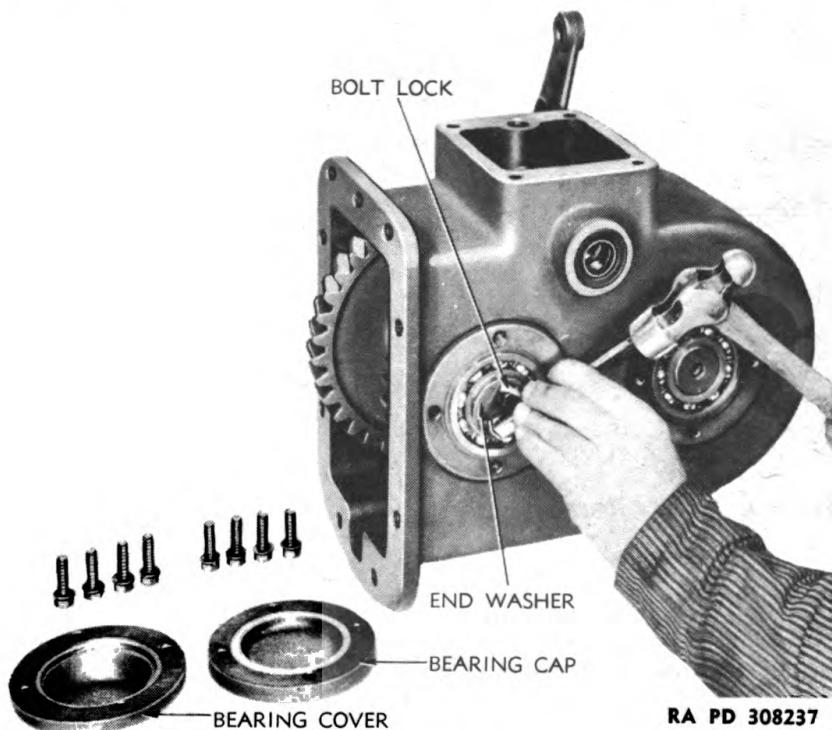
b. Remove Drive Shaft and Gears. Remove bearing cover from front side of case (fig. 134) by removing four cap screws from cover. Bend bolt lock away from cap screw heads (fig. 135) and remove cap screws and end washer from end of shaft. Using brass drift, drive shaft toward front of case far enough to uncover snap ring (fig. 136). Expand snap ring out of groove and move it toward front of case. Then drive shaft out of rear of case, removing drive pinion, snap

POWER TAKE-OFF



RA PD 308236

Figure 134 — Removing Drive Shaft Bearing Cover



RA PD 308237

Figure 135 — Straightening Bolt Lock To Remove Drive Shaft

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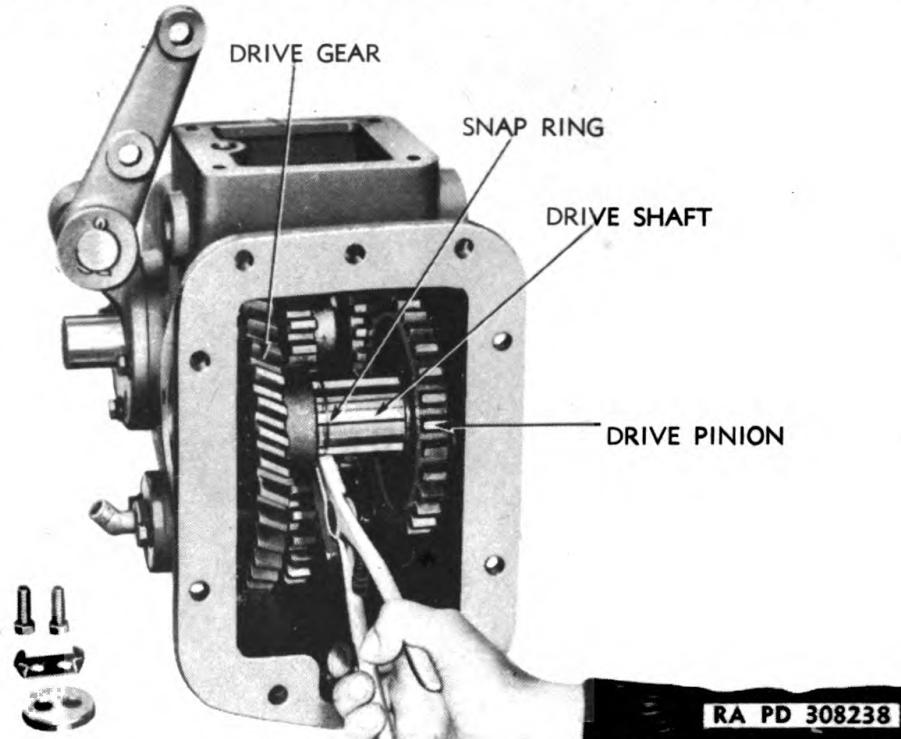


Figure 136 – Snap Ring Removed From Groove in Shaft

ring, and drive gear as shaft is removed. Press or drive bearing from case. Press bearing from shaft and remove spacing washer.

c. Remove Driven Shaft and Gears. Remove front and rear driven shaft bearing retainers by removing four cap screws from each (fig. 137). Using brass drift bar, drive shaft toward rear of case until bearings are driven out of case. Hold gears flat against rear of case, and drive shaft out of front bearing, spacer washer, and gears. Lift these parts from case as they are freed by shaft. Press rear bearing from shaft and remove snap ring. Inspect oil seal in retainer. If it is to be replaced, drive it out of retainer with punch and hammer. If removed, a new seal must be installed as old one will be spoiled in removal.

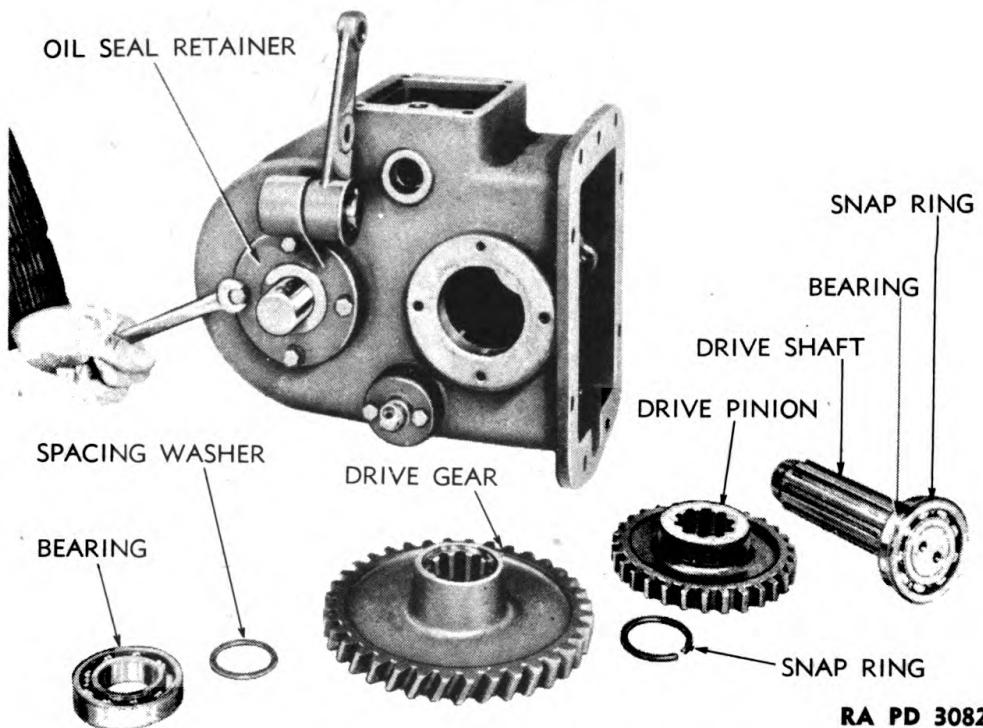
d. Remove Reverse Idler Shaft and Gear. Remove the two cap screws and lift cover from end of reverse idler shaft. Tap shaft out of case, removing steel lock ball (fig. 138) when shaft is driven out about 1 inch. Remove idler gear as shaft is removed (fig. 139).

57. INSPECTION AND REPAIR OF PARTS.

a. Clean Parts. Remove all old gaskets and wash all parts thoroughly with dry-cleaning solvent and blow dry with compressed air.

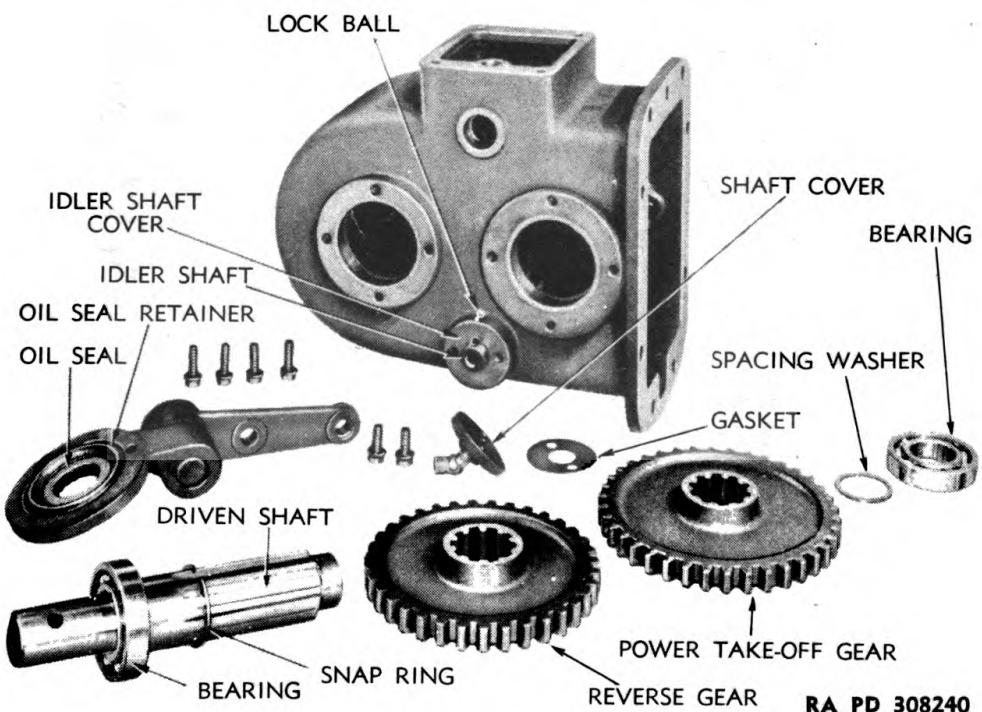
b. Inspect Gears. Inspect all gears for wear, broken teeth, or cracks and checks in hubs. Replace badly worn or defective gears.

POWER TAKE-OFF



RA PD 308239

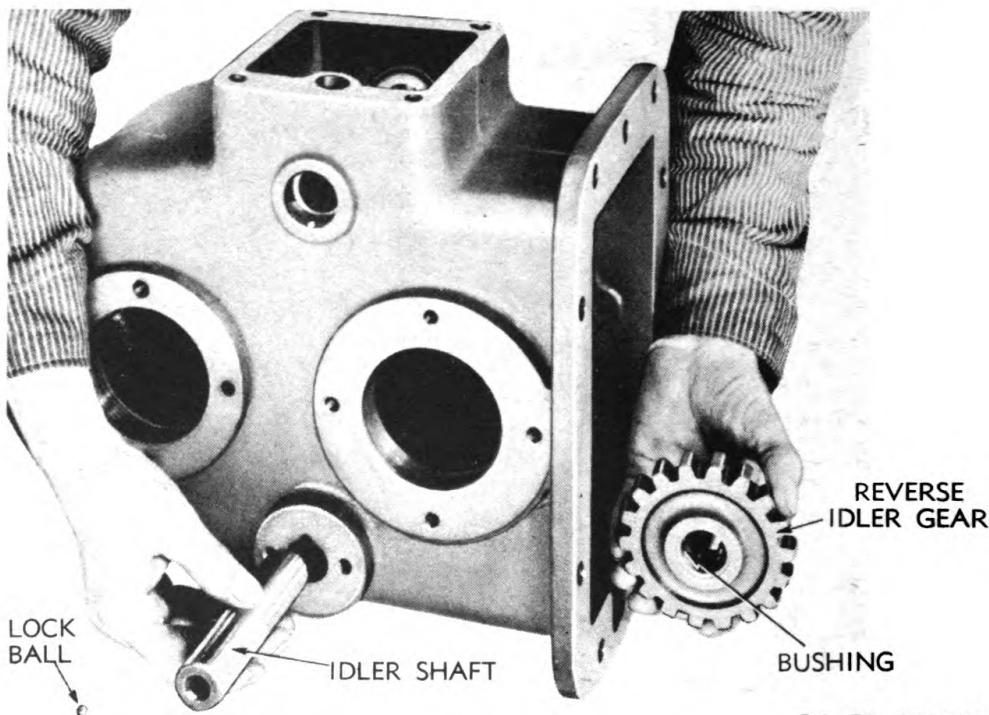
Figure 137 — Removing Oil Seal Retainer



RA PD 308240

Figure 138 — Driven Shaft and Gears Removed

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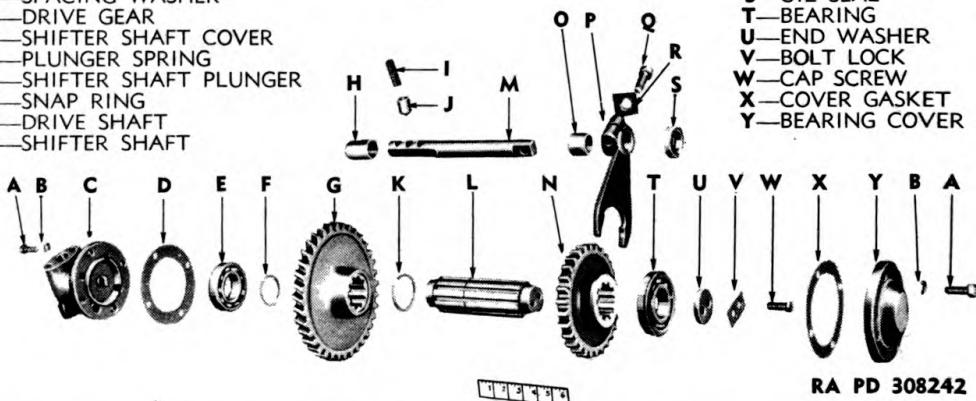


RA PD 308241

Figure 139 – Reverse Idler Shaft and Gear Removed

A—BOLT
B—LOCK WASHER
C—TRANSMISSION OIL PUMP
D—OIL PUMP GASKET
E—BEARING
F—SPACING WASHER
G—DRIVE GEAR
H—SHIFTER SHAFT COVER
I—PLUNGER SPRING
J—SHIFTER SHAFT PLUNGER
K—SNAP RING
L—DRIVE SHAFT
M—SHIFTER SHAFT

N—DRIVE PINION
O—SPACER
P—SHIFTER FORK
Q—CLAMP SCREW
R—SCREW LOCK
S—OIL SEAL
T—BEARING
U—END WASHER
V—BOLT LOCK
W—CAP SCREW
X—COVER GASKET
Y—BEARING COVER

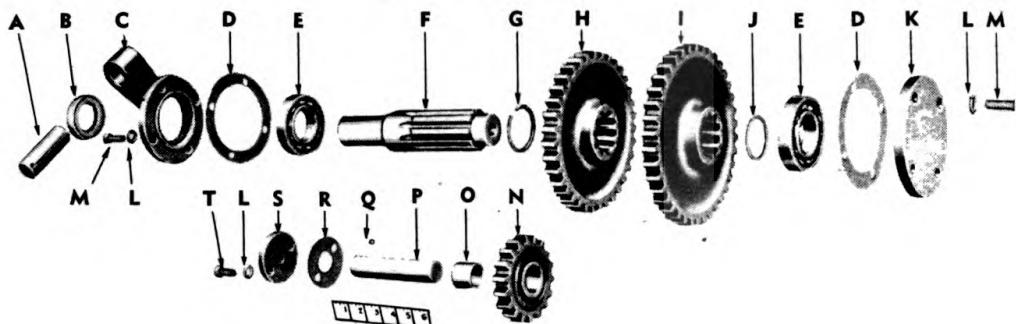


RA PD 308242

Figure 140 – Power Take-off Drive Shaft and Gears Disassembled

Inspect the splines in shafts and gears and dress rough places, if any, with a file or stone. If ends of gear teeth are rough or jagged, replace the gears or smooth up ends of teeth. Try gears on their respective shafts to make sure they slide easily in the splines. Test to see that bearings fit snugly on their respective shafts. If loose, replace either shaft or bearing, whichever one is worn.

POWER TAKE-OFF



A—LEVER PIVOT PIN
 B—OIL SEAL
 C—OIL SEAL RETAINER
 D—BEARING COVER GASKETS
 E—BEARINGS
 F—DRIVEN SHAFT
 G—SNAP RING
 H—REVERSE IDLER GEAR
 I—POWER TAKE-OFF GEAR
 J—SPACING WASHER
 K—BEARING CAP
 L—LOCK WASHERS
 M—CAP SCREWS
 N—REVERSE IDLER GEAR
 O—BUSHING
 P—IDLER SHAFT
 Q—LOCK BALL
 R—COVER GASKET
 S—SHAFT COVER
 T—CAP SCREW

RA PD 308243

Figure 141 — Driven Shaft and Reverse Idler Shaft and Gears Disassembled

c. Bearings. Check bearings for chipped or rough rollers. Replace worn or defective bearings. If bearing rollers or cups are blue or dark colored, it indicates that they have been overheated and should be replaced. Bearing races must be smooth and bright.

d. Reverse Idler Gear Assembly. If bushing in reverse idler gear or idler gear shaft is worn, replace either bushing or shaft, or both, if necessary. If bushing is replaced, the new bushing must be pressed into gear and reamed to fit shaft with enough clearance to rotate freely. The original diameter of idler shaft is 0.995-1.000 inch; the inner diameter of bushing is 1.003-1.005 inches.

e. Replace oil seals if worn or damaged. Examine gear case for cracks or breaks. Small breaks or cracks may be repaired by welding or brazing. Shifter fork may be built up to original thickness (0.360-0.370 inch), if worn, by welding or brazing, and then ground flat and smooth so it works freely in collar of drive pinion. Replace yoke pins in control linkage, if worn, to allow more than 0.010- to 0.015-inch looseness. Weld shut and redrill elongated holes in levers.

58. ASSEMBLY.

a. Install Reverse Idler Shaft and Gear. Insert closed end of reverse idler shaft through rear side of case, and slide reverse idler gear (18 teeth) onto inner end of shaft (fig. 139). Align hole in side of shaft with slot in case (fig. 138), place steel lock ball in hole in shaft, and slide shaft on into case. The lock ball is to prevent shaft from turning. Install idler shaft cover with gasket using 2 cap screws with lock washers.

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b. Install Driven Shaft and Gears. Press bearing onto long end of shaft against shoulder and install snap ring in groove in splines of shaft (fig. 138). Insert splined end of shaft through rear side of case and slide 35-toothed reverse gear, then 38-toothed gear, onto shaft. Insert shaft on through case, tapping bearing on shaft into bore in case. Press oil seal into oil seal retainer with lip of seal facing inner side of retainer. Using new gasket, slide retainer over shaft and secure to case with four cap screws with lock washers (fig. 137). Slide spacing washer onto front end of shaft, then drive or press front bearing onto shaft and into case. Use new gasket and install bearing cap with four cap screws with lock washers.

c. Install Drive Shaft and Gears. Install snap ring on front bearing (groove in outer race). Press this bearing onto end of drive shaft that has two holes in it (fig. 137). Install end washer on end of shaft with two cap screws and nut lock (fig. 135). Insert other end of shaft through front of case and slide 29-toothed drive pinion (shifter collar end first) onto shaft. Install snap ring in groove in splines of shaft, then slide 36-toothed drive gear (long end of hub first) onto shaft against snap ring. Tap front bearing into case, then slide spacing washer on rear end of shaft and install rear bearing in case over end of shaft. Bend ends of nut lock against sides of cap screw heads (fig. 135), then install bearing cover with new gasket on front of case with four cap screws with lock washers (fig. 134).

d. Install Shifter Shaft and Fork. Insert notched end of shifter shaft through rear side of case and slide spacer onto shaft. Set shifter fork in collar of drive pinion with long end of shaft bore toward rear of case, turn shaft so lock notches are on upper side and slide shaft until notch closest to end of shaft can be seen in center of hole in top of case. Hold shaft in this position and mesh drive pinion with drive gear, then install and tighten clamp screw in top of fork. When shaft and gear are now moved so that center notch in shaft can be seen in center of hole, gears should be completely disengaged. Slide oil seal over front end of shifter shaft (lip of seal facing out) and tap it into case (fig. 134). Drive shifter shaft cover into rear of case (fig. 133).

e. Install Top Cover. Drop shifter shaft plunger and spring into hole in top of case. Using new gasket, install top cover and steering brake return spring bracket on case with four cap screws with lock washers as shown in figure 132.

CHAPTER 9

MAIN FRAME, FUEL TANK, AND PINTLES

Section I

MAIN FRAME

59. DESCRIPTION.

a. The main frame (hull) of the tractor has two side members, a bottom, and one closed end fabricated more or less like a box with appropriate braces and reinforcing on the inside to withstand operating strains. The front end of the frame is open to receive the transmission, differential, and final drive assembly, this assembly being suspended on the front end of the two side members. Inspection and hand holes are provided in the bottom of the hull with covers that can be removed to gain access to the engine and drain plugs of various units in the vehicle. With front bumper and front guard plates and bottom covers installed, the hull is watertight enough to permit vehicle to cross streams in which hull will be partially submerged. A lever-operated hull drain valve provides for immediate draining of hull after emerging from a crossing.

60. MAINTENANCE.

a. Inspect the hull at regular intervals and especially when a major assembly is removed which will allow more chance for inspection. If any welded joints are cracked or bracing has loosened, these should be immediately rewelded. Replace bottom covers or cover gaskets if lost or damaged. Tighten loose bolts and replace any bolts that are missing at each inspection interval.

Section II

FUEL TANK

61. DESCRIPTION OF TANK.

a. The fabricated sheet steel fuel tank is located in right side of hull and has a capacity of 125 gallons. A sediment sump with drain valve in bottom of tank provides a means of draining water and sediment out of the tank. A pipe extends upward from top of tank to provide proper venting of gases. The battery is carried in a square recess built into left side of tank, and two other brackets welded in tank, support the fan belt tightener and generator. Baffle plates inside of tank provide reinforcing of sides. The level of the fuel in

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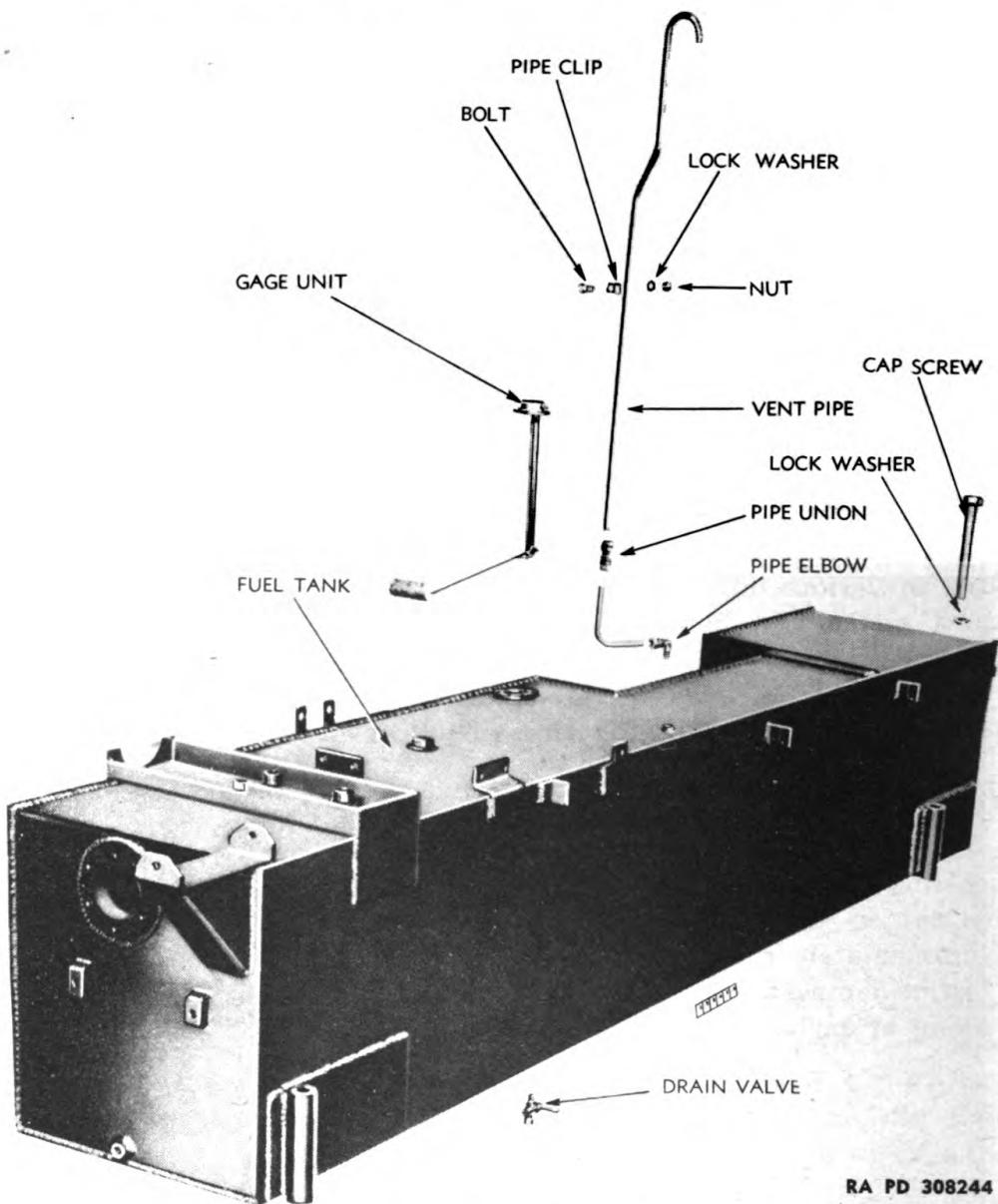


Figure 142 – Fuel Tank and Related Parts

the tank is registered on the gage in instrument panel which is connected to the operating float unit on tank.

62. REPLACEMENT OF TANK.

- a. The replacement of the fuel tank necessitates the removal of the cab and seats and battery. After these have been removed, disconnect the filler pipe from rear of tank and remove the fan belt tightener and generator from the brackets on tank. Close main valve

MAIN FRAME, FUEL TANK, AND PINTLES

and remove the fuel filter from tank, and disconnect the heater lines, wires and clips from tank. Remove the four long bolts that secure tank in hull and raise tank from hull, sliding it forward at same time to clear radiator supporting frame. Reverse this procedure to install the replacement tank.

Section III

PINTLES

63. DESCRIPTION.

a. The two different kinds of pintles furnished with the tractor are of the standard-ordnance type and interchangeable on the tractor. They are exactly the same, except that the one designed to pull the 90-mm and 3-inch antiaircraft guns has a universal swivel and yoke (fig. 143), while the one designed to pull the 155-mm or 8-inch howitzers, and 240-mm gun has a hook for connection with the howitzers or gun (fig. 144). A single large spring in the housing, cushions shocks from starting, stopping, and towing of load.

b. Removal and installation of pintles is explained in TM 9-785.

64. DISASSEMBLY.

a. **Separate Front and Rear Housings.** Pull cotter pin from rear end of shaft and stop. Remove stop from end of shaft. Remove the two cap screws that attach the front and rear pintle housings. Remove front housing and gasket from rear housing. Drive spring seat from front housing. Remove spring and spring seat from shaft. Remove pintle shaft assembly from rear housing.

b. **Disassemble Yoke and Cross (on Pintle for 90-mm gun).** Pull cotter pin from yoke cross pin and remove slotted nut and flat washer. Tap cross pin out of yoke cross and remove the two needle bearings and spacer from cross. Remove second cross pin and bearings in same manner. Remove lubricating fittings from cross pins.

c. **Disassemble Pintle Hook (on Pintle for 155-mm gun).** Remove the cap screw from pintle latch (fig. 144). Slide latch pin out of latch and pintle lock to remove latch. Pull cotter pin from lock bolt, remove nut, and slide bolt out of lock and hook to separate lock from hook.

65. INSPECTION AND REPAIR OF PARTS.

a. **Clean Parts.** Wash all parts thoroughly with dry-cleaning solvent and dry with compressed air. Discard all broken or worn parts that cannot be repaired.

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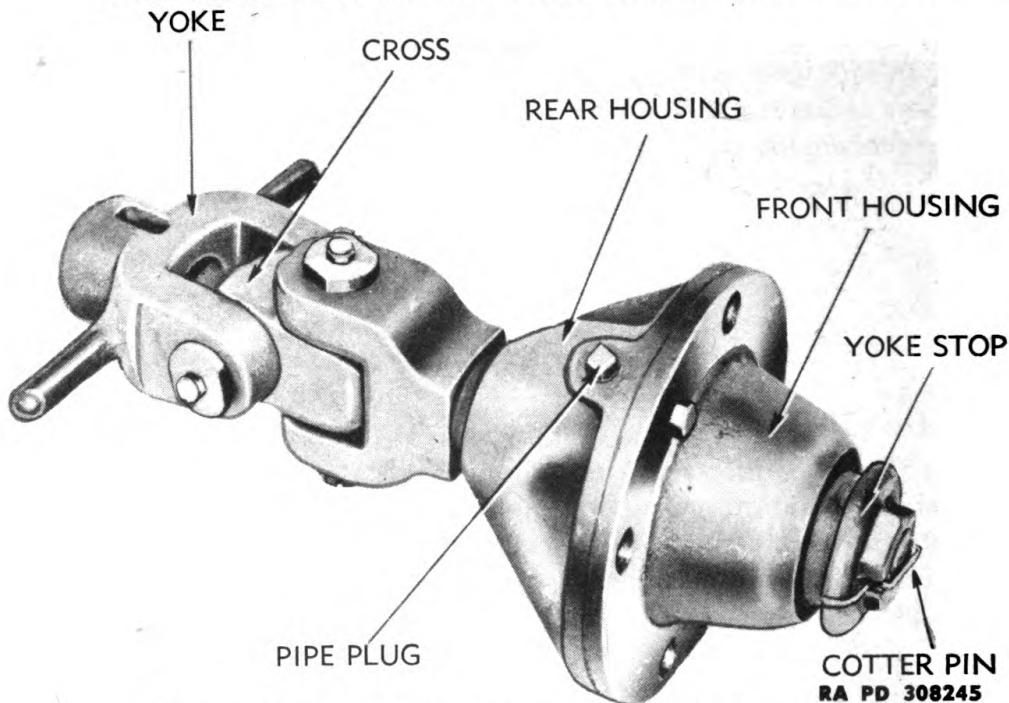
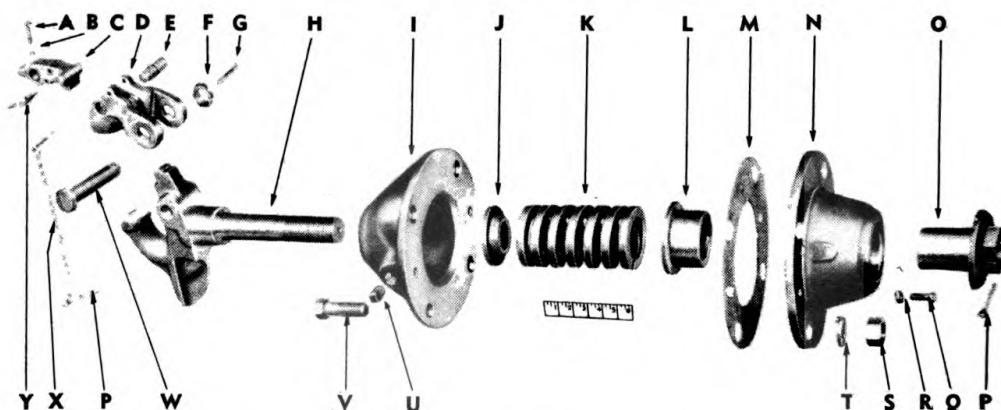


Figure 143 — Pintle Assembly (for 90-mm Gun)



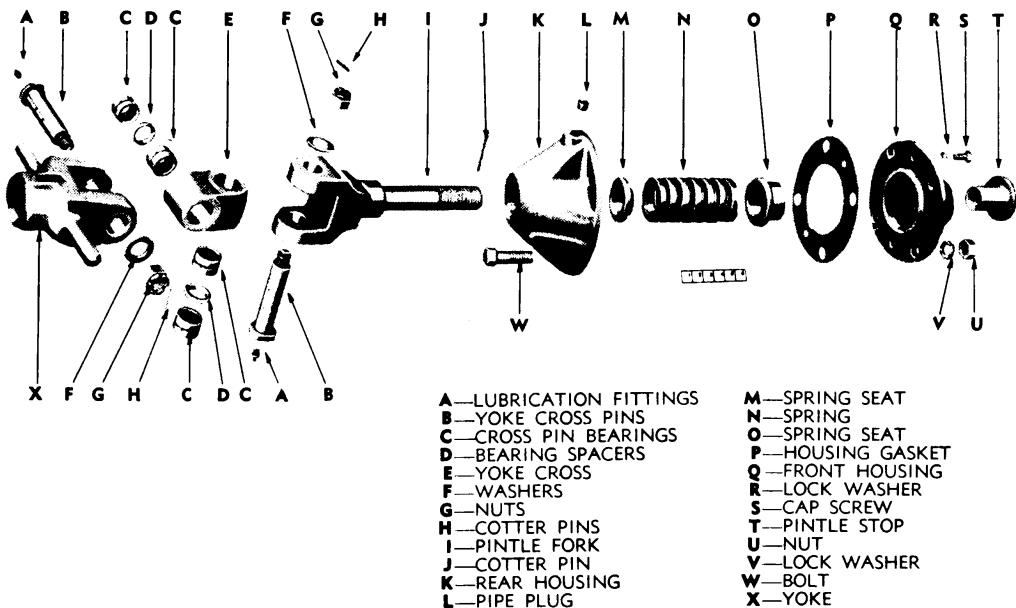
A—CAP SCREW	J—SPRING SEAT	R—LOCK WASHER
B—LOCK WASHER	K—SPRING	S—NUT
C—PINTLE LATCH	L—SPRING SEAT	T—LOCK WASHER
D—PINTLE LOCK	M—HOUSING GASKET	U—PIPE PLUG
E—LATCH PIN	N—FRONT HOUSING	V—BOLT
F—NUT	O—YOKE STOP	W—LOCK BOLT
G—COTTER PIN	P—COTTER PIN	X—HOOK CHAIN
H—PINTLE HOOK	Q—CAP SCREW	Y—LATCH SPRING
I—REAR HOUSING		

RA PD 308246

Figure 144 — Pintle for 155-mm Gun Disassembled

b. Pintle Assembly. Inspect shaft for straightness and general wear. Straighten shaft if bent. If shaft is worn, it must be replaced or worn places built up by welding and then turned to proper size (1.739-1.743 in. diameter) in a lathe. Inspect threads on rear end of

MAIN FRAME, FUEL TANK, AND PINTLES



RA PD 308247

Figure 145 — Pintle for 90-mm Gun Disassembled

shaft and pintle yoke stop, replace shaft or stop if threads are not in good condition unless they are only slightly burred and can be traced with a lathe. Replace broken or badly worn spring, spring seats, or pintle housing.

c. **Yoke and Yoke Cross and Pintle Hook.** Inspect bearings and cross pins in yoke cross; replace broken or damaged bearings. Make sure passages for lubrication are open. Replace cross pins that are worn or chipped and rough. Replace or repair broken or damaged parts of hook or latch of pintle for 155-mm gun. If welding is done on any of these parts, make sure the parts are ground to aline properly and work freely.

66. ASSEMBLY.

a. **Assemble Yokes and Cross of Pintle for 90-mm Gun** (fig. 145). Fill recess in yoke cross bearing retainers with chassis grease and place rollers in retainer. The grease will hold them in place. Slip two bearings with spacer between them onto one of the two yoke cross pins. Tap bearings and spacer into yoke cross, then slip pin back out of bearings. Hold trailing pintle yoke in position over yoke cross and insert cross pin through one side of yoke, through yoke cross, and to other side of yoke. Install flat washer and nut on end of pin and tighten nut. Install cotter pin after tightening nut. Assemble second set of yoke cross pin bearings in same manner as in first set and connect yoke cross to pintle yoke on shaft in same manner as trailing yoke was connected to yoke cross. Install lubricating fitting in each cross pin.

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b. Assemble Pintle Hook for 155-mm Gun (fig. 144). Connect lock to hook with bolt and nut; secure nut with cotter pin. Set latch and spring in lock and slide latch pin through latch and lock. Install cap screw with lock washer in latch to secure latch pin. Install pintle hook chain and cotter pin in latch.

c. Assemble Pintle Housing and Hook or Yoke. Slide rear housing onto shaft, then spring seat with machined surface of seat towards housing. Cement connecting gasket to flange of housing. Slide pintle spring onto shaft. Tap front spring seat into bore in front housing from inside. Cement gasket to attaching face of housing and slide housing over shaft. Install pintle stop nut and draw spring together until two cap screws with lock washers can be installed and tightened to attach front and rear housings. Tighten stop nut until cotter pin can be installed through stop nut and shaft. Install cotter pin. Fill housing with lubricant and lubricate bearings in yoke cross with chassis grease. Install pipe plug in rear housing.

CHAPTER 10

SPECIAL TOOLS

67. SPECIAL MAINTENANCE TOOLS.

a. Special tools for the maintenance of the tractor which are available to ordnance maintenance personnel are listed below. This list does not include special tools for the engine and torque converter as these are listed in TM 9-1785A.

Special Tools	Ord. No.	Fed. Stock No.
Adapter, puller, pin and shaft (use w/41-P-29 5-60) (2)	B-347830	41-A-18-235
Adapter, sprocket shaft (use w/41-P-2957-100)	A-347829	
Compressor, bogie spring (1)	A-334693	41-C-2547-10
Handle, bushing removers and replacers, 3 in. long, use (w/41-H-1396-655) (1)	A-346130	41-H-1396-650
Handle, bushing removers and replacers, 3 in. long (use w/41-H-1396-650) (3)	B-283308	41-H-1396-655
Puller, slide-hammer type, final drive sprocket pin and trailing idler pivot shaft, with adapter B-247829 (1)	B-283349	41-P-2957-100
Remover and replacer, bogie wheel shaft (1)	B-283311	41-R-2378-598
Remover and replacer, bushing, steering brake drum (1)	B-283307	41-R-2376-295
Remover and replacer, bushing, steering brake control shaft (1)	A-346136	41-R-2376-290
Remover and replacer, final drive shaft bushing, outer bearing (1)	B-283305	41-R-2374-875
Remover and replacer, inner bearing cup, final drive shaft (1)	B-283304	41-R-2374-670
Remover and replacer, lock ring, transmission (1)	B-283303	41-R-2378-590
Tool, unlocking, bogie wheel bearing retainer (1)	B-283306	41-T-3380-30
Wrench, pronged, bogie wheel bearing retainer nut (1)	C-139578	41-W-3825-130
Wrench, spanner hook (1)	B-283343	41-W-3250-10

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1 2 3 4 5 6

41-R-2376-295
REMOVER AND REPLACER



41-R-2376-290

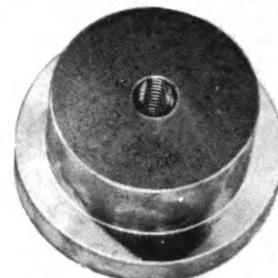
1 2 3 4 5

REMOVER AND REPLACER



1 2 3 4 5 6

41-R-2374-670
REMOVER AND REPLACER



41-R-2374-875
REMOVER AND REPLACER



41-H-1396-655

1 2 3 4 5 6

HANDLES

41-H-1396-650

1 2 3 4 5

HANDLE

RA PD 308248

Figure 146 – Special Maintenance Tools

SPECIAL TOOLS

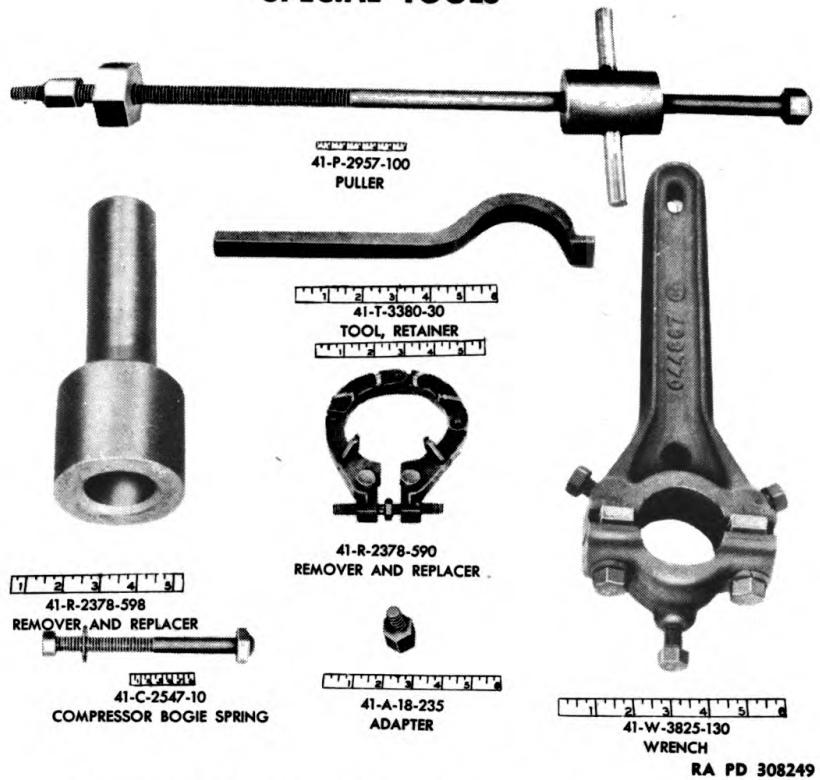


Figure 147 — Special Maintenance Tools

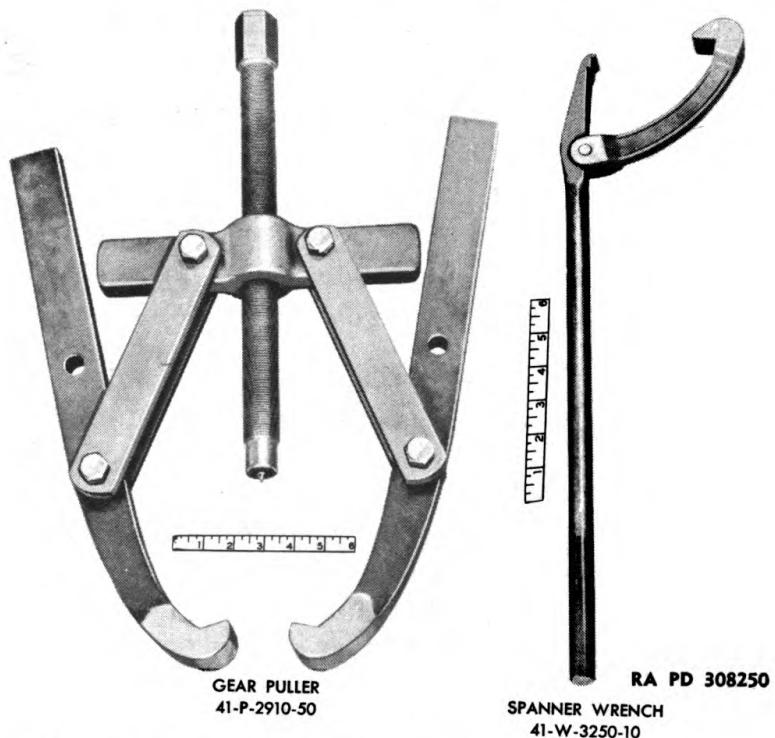


Figure 148 — Special Maintenance Tools

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REFERENCES

PUBLICATIONS INDEXES.

The following publications indexes should be consulted frequently for latest changes or revisions of the publications given in this list of references and for new publications relating to materiel covered in this manual:

Introduction to Ordnance Catalog (explaining SNL system)	ASF Cat. ORD 1 IOC
Ordnance Publications for Supply Index (index to SNL's)	ASF Cat. ORD 2 OPSI
Index to Ordnance Publications (listing FM's, TM's, TC's, and TB's of interest to ordnance personnel, OPSR, MWO's, BSD, S of SR's, OSSC's, and OFSB's, and includes Alphabetical List of Major Items with Publications Pertaining Thereto)	OFSB 1-1
List of Publications for Training (listing MR's, MTP's, T/BA's, T/A's, FM's, TM's, and TR's concerning training)	FM 21-6
List of Training Films, Film Strips, and Film Bulletins (listing TF's, FS's, and FB's by serial number and subject)	FM 21-7
Military Training Aids (listing Graphic Training Aids, Models, Devices, and Displays)	FM 21-8

STANDARD NOMENCLATURE LISTS.

Cleaning, preserving and lubrication materials, recoil fluids, special oils, and miscellaneous related items	SNL K-1
General tools, and supplies, ordnance base automotive maintenance company power train rebuild	SNL N-328
Ordnance maintenance sets	SNL N-21
Soldering, brazing and welding materials, gases and related items	SNL K-2
Tool-sets, motor transport	SNL N-19
Tool-sets, for ordnance service command automotive shops	SNL N-30
Tools, maintenance for repair of automotive vehicles	SNL G-27 Vol. 1
Tractor, high speed, 18-ton, M4	SNL G-150

REFERENCES

EXPLANATORY PUBLICATIONS.

Fundamental Principles.

Automotive Power Transmission Units	TM 10-585
Basic Maintenance Manual	TM 10-38-250
Fuels, lubricants, cleaners, and preservatives	TM 9-2835
Military motor vehicles	AR 850-15
Motor vehicle inspections and preventive main- tenance service	TM 9-2810
Precautions in handling gasoline	AR 850-20
Sheet metal work, body, fender, and radiator re- pairs	TM 10-450
Standard Military Motor Vehicles	TM 9-2800
The machinist	TM 10-445

Maintenance and Repair.

Cleaning, preserving, lubricating and welding materials and similar items issued by the Ord- nance Department	TM 9-850
Cold weather lubrication and service of combat vehicles and automotive materiel	OFSB 6-11
Ordnance maintenance: Engine, engine acces- sories, and torque converter for 18-ton M4 and 38-ton M6 high speed tractors	TM 9-1785A

Operation of Materiel.

18-ton high-speed tractor M4	TM 9-785
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Protection of Materiel.

Camouflage	FM 5-20
Chemical decontamination materials and equip- ment	TM 3-220
Decontamination of armored force vehicles	FM 17-59
Defense against chemical attack	FM 21-40
Explosives and demolitions	FM 5-25

Storage and Shipment.

Ordnance storage and shipment chart, group G — Major items	OSSC-G
Registration of motor vehicles	AR 850-10
Rules governing the loading of mechanized and motorized army equipment also major caliber guns, for the United States Army and Navy, on open top equipment published by Opera- tions and Maintenance Department of Associa- tion of American Railroads.	
Storage of motor vehicle equipment	AR 850-18

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